Appendix E:
Hydrology Report and
Low Impact Development Plan

Part 1: Hydrology & Hydraulic Study for Tract Map No. 83215

HYDROLOGY & HYDRAULIC STUDY FOR TRACT MAP NO. 83215

CITY OF COVINA
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JANUARY 17, 2019
REVISED OCTOBER 9, 2019
REVISED NOVEMBER 25, 2019

This report has been prepared by or under the direction of the following registered civil engineer who attests to the technical information contained herein. The registered civil engineer has also judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

11/25/2019

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I. PURPOSE AND SCOPE

The purpose of this study is to determine the necessary drainage improvements and increased runoff mitigation improvements required for Tract Map No. 82315. Tract 82315 is a proposed commercial site and high density development that lies on approximately 8 acres within a developed area of Covina. See Figure 1 Vicinity Map.

The scope of the study includes the following:

1. Determination of points of flow concentration and watershed subareas for onsite tributary areas.
2. Determination of 25-year storm event flow rates to catch basins and inlets proposed within the project area utilizing the Modified Rational Method as outlined in the Los Angeles County Department of Public Works (LACDPW) Hydrology Manual.
3. Determination of the peak storm flows and hydrographs for the post-project conditions for the area tributary to the proposed subsurface increase runoff basin for the 25-year storm event. The LACDPW has indicated that the allowable flow rate can not exceed 0.77 ft^3/s per acre.
4. Determine the limits of storm drain required to flood protect the project site and meet the LACDPW requirements for the 25-year storm events and perform hydraulic calculations in support of the proposed design.
5. Perform basin calculations in support of the basin design to ensure the design will mitigate runoff to be less than the allowable flow rate identified by LACDPW as 0.77 ft^3/s per acre.
6. Preparation of a hydrology and hydraulics report, which consist of hydrological and analytical results and exhibits.

II. PROJECT SITE AND DRAINAGE AREA OVERVIEW

Tract 83215 is a proposed commercial and single family residential development that proposes to construct a total of 61 residential homes, a subsurface basin, subsurface storm drain, and internal streets. The approximately 8 acre project is located within the City of Covina and is bounded by Covina Boulevard to the north, Cypress Street to the south, Azusa Avenue to the west, and Conwell Avenue to the east.

The existing project site is currently a supermarket center that is no longer operational. The project is surrounded by residential homes to the north and west and commercial property to the south. Figure 3 shows the existing condition commercial center and the existing topographic mapping indicates that 5.64 acres flows towards Azusa Avenue and 2.19 acres flows to Cypress Street.

The project site will collect the onsite flows via curb and gutters, catch basins and subsurface storm drain. The onsite flows will be conveyed to three proposed subsurface basins within the project site. The subsurface systems have been designed to retain the water quality volume for the proposed commercial center. The subsurface system within the high density residential area will flow to two subsurface basins in order to store the required volume necessary to mitigate

for increased runoff associated with the 25-year storm event to be equal to the allowable flow rate provided by LACDPW and to mitigate increased runoff.

The three onsite basins have been designed to allow water quality volume to infiltrate. The two subsurface systems in the high density residential area and the volume in excess of the water quality volume will be metered through an orifice plate to restrict the flows not to exceed 0.77 ft^3/s per acre.

III. HYDROLOGY

The LACDPW Hydrology Manual (Reference 1), was used to develop the hydrological parameters for the hydrology analyses. The modified rational method was used for the analyses and the computations were performed using the HydroCalc 3.1 software developed by LACDPW.

The rainfall and soil parameters for the project were obtained from the LACDPW Hydrology Manual, see Exhibit C. The hydrology parameters for the modified rational method calculations are as follows:

- 50 Year, 24 Hour Rainfall – 7.2 inches
- Soil Classification – 006
- Storm Drain Design Frequency – 25 Year Event
- Commercial Impervious Area 96% per LACDPW Hydrology Manual Appendix D
- High Density Residential Impervious Area 67% which is based on the LID Study.

The hydrology analyses performed for the project site was developed in the following manner:

1. Identify areas tributary to the proposed catch basin and inlet structures. The areas tributary to the proposed catch basins and inlets are shown on Exhibit A, Catch Basin & Inlet Hydrology. The flow rates tributary to the proposed catch basins and inlets will be used to size the proposed storm drain systems. The project was broken into three watershed areas defined as Area A, B and C.
2. The subarea boundary tributary to each catch basin have been identified. Calculations were performed to determine the peak flow rate for each catch basin and inlet.
3. Additionally, the total area for watersheds A, B and C were used to perform a hydrology analyses to establish a peak flow rate and hydrograph. The hydrographs were used to size the proposed subsurface basins to mitigate the increase runoff to a level that is equal or less than the allowable flow rate.

Catch Basin and Inlet Hydrology

Exhibit A identifies the total area tributary to each catch basin and inlet structure proposed for the project. There are a total of 8 catch basins/grate inlets to intercept the onsite runoff and

convey the flows to one of the three subsurface basins. The 5 drainage areas are analyzed with the following impervious areas:

Subarea	Area (ac)	Impervious Fraction
1A	2.93	0.96
1B	1.94	0.67
2B	1.19	0.67
3B	0.65	0.67
1C	1.12	0.67

The impervious percentages were obtained from the LACDPW Hydrology Manual. However, the LID Study defined an impervious percentage of 67% which is greater than the recommended value. For consistency, this report used the value identified in the LID Study.

The LACDPW Hydrology Manual requires projects that are within developed areas and not covered by the Capital Flood Protection Conditions, identified in LACDPW Hydrology Manual Section 4.2, to provide protection per the Urban Flood Protection Condition discussed in LACDPW Hydrology Manual Section 4.3. The Urban Flood is defined as runoff associated with a 25-year storm event. The design of the proposed catch basins and inlets are designed to intercept the 25-year peak flow rate at all proposed catch basins/inlets. The following table provides the 25-year rates:

Table 1 – Peak Flow Rates for Catch Basins & Inlets

Subarea	Drainage Area (acres)	Catch Basin/Inlet Designation	25-Year Flow Rate (ft^3/s)
1A	2.93	1A	8.47
1B	1.94	1B	5.13
2B	1.19	2B	3.37
3B	0.65	3B	2.18
1C	1.12	1C	3.76

The hydrology calculations for the areas tributary to the catch basins have been included in Appendix A.

Subsurface Basin Hydrology

Exhibit B identifies the total area tributary to the Basin A, Basin B and Basin C, which are proposed 96" CMP subsurface basins that are designed to retain the water quality volume and mitigate increased runoff for the project. The project site will mitigate flows for increased runoff and ensure that flows discharging from the project site are less than the allowable flow rate provided by LACDPW for the subsurface systems within the high density residential area. The subsurface system within the commercial area, as shown on Exhibit B is solely for the water quality volume. The proposed commercial site will not impact Azusa Avenue since the drainage area for the post-project condition decreased from 5.64 acres to 2.93 acres. This will

result in a lower runoff rate allowed to flow within Azusa Avenue since the land uses and impervious area are identical. In order to determine the post-project flow rates, hydrology calculations were performed for the 25-year storm event for the entire area tributary to each subsurface system, which are defined as Areas 1B, 2B & 3B, and Area 1C. The table below provides the peak flow rate and allowable flow rate for each basin.

Table 2 – Peak Flow Rate for Basins (96" CMP Subsurface Basin)

Subsurface Basin	Subareas	Drainage Area (acres)	25-Year Flow Rate (ft^3/s)	Allowable Flow Rate (ft^3/s)
B	**1B, 2B, & 3B**	3.78	10.0	2.91
C	**1C**	1.12	3.8	0.86

The hydrology calculations for Basin B and Basin C have been included in Appendix B. In order to meet the requirements provided by LACDPW and to discharge into the existing 69-inch storm drain located within Cypress Street, the project cannot exceed the allowable flow rate provided in Table 2. There are no calculations for the Basin A since this system is solely for water quality volume. This analysis is part of the LID Study.

IV. BASIN SIZING CALUCLATIONS

The subsurface system will be designed to store the volume associated with the water quality volume and the volume required to mitigate for increased runoff. The allowable flow rate provided in Table 2 and the hydrograph table provided in Appendix B will be used to size the subsurface basin system. Prior to commencing the subsurface basin sizing the water quality volume for each subsurface basin were calculated in the Standard Urban Stormwater Mitigation Plan prepared by Land Development Consultants and the results are shown in Table 3.

Table 3 – Water Quality Volume for Basins (96" CMP Subsurface Basin)

Subsurface Basin	Subareas	Drainage Area (acres)	Water Quality Volume (ft^3)
A	**1A & 2A**	2.93	7,002
B	**1B, 2B, & 3B**	3.78	8,556
C	**1C**	1.12	2,746

The subsurface basin systems are designed to allow the water quality flow rates and volume to infiltrate into the in-situ soils, since the geotechnical reports indicate that the project has infiltration rates that range from 1.3 inches /hour to 3.3 inches /hour. The report for the infiltration rates have been included in Appendix G. The lower half of the subsurface basin systems will be used solely to impound the water quality volume and promote groundwater infiltration.

In order to accurately size the subsurface system, the unit hydrograph (included in Appendix B) for the post-project condition was utilized (in 5 minute increments) to find the location of the

allowable flow rate, based on Table 2, on the rising and recess limbs of the hydrograph to assess the required storage volume. Table 4 provides the required storage volume for each subsurface basin based on the designed outflow which is less than the allowable flow rate:

Table 4 – Water Quality Volume for Basins (96" CMP Subsurface Basin)

Subsurface Basin	Subareas	Allowable Flow Rate (ft^3/s)	Designed Outflow Flow Rate (ft^3/s)	Increased Runoff Volume (ft^3)
B	**1B, 2B, & 3B**	2.91	2.8	8,565.2
C	**1C**	0.86	0.7	2,961.7

The increased runoff volume shown on Table 4 was calculated by locating the difference in volume using the unit hydrograph table in Appendix B. The subsurface basin must store the volume between flow rates that are less than the allowable flow rates. The design outflow shown on Table 4 was selected from the hydrograph table shown on the table in Appendix B. The design outflow was selected to be a value less than the allowable flow rate. During final engineering a more detailed basin routing analyses will be performed.

Moreover, the subsurface basin must store the "Required Volume", which equals to the sum of the "Water Quality Volume" and "Increased Runoff Volume". Table 5 provides the "Required Volume" and the proposed "Design Volume" which is based on the preliminary design of the subsurface basins. Figure 2 and Figure 3 are typical section of a Double CMP Subsurface System and a Single CMP Subsurface System. Basin B is a Double CMP Subsurface Systems that can store 148.4 cubic feet per foot of system. Moreover, Basin A and C is a Single CMP Subsurface System that can store 74.2 cubic feet per foot of system. The subsurface basins systems are perforated CMP pipe with a gravel bed that allows flows to infiltrate into the in-situ soil. The tables In Appendix C provide the storage volume calculations for each subsurface system.

Table 5 – Required Volume and Preliminary Design Volume for Subsurface Basins (96" CMP Subsurface Basin)

Subsurface Basin	Subareas	Drainage Area (acres)	Required Volume (ft^3)	Design Volume (ft^3)
A	**1A & 2A**	2.93	7,002	7,416
B	**1B, 2B, & 3B**	3.78	17,294.7	17,502
C	**1C**	1.12	5,548.2	5,995

The preliminary subsurface basins Design Volume has provided sufficient storage to mitigate the water quality runoff and increased runoff volumes to prevent downstream impacts.

V. STORM DRAIN SYSTEMS

Tract 82315 is proposed to discharge into the LACDPW Line A Storm Drain system located within Cypress Street. The LACDPW has provided documentation that indicate that the project is allowed to discharge 0.77 ft^3/s per acre, see Appendix F. Table 2 provides the peak allowable

flow rate which will be released by the subsurface basins. The Line A Storm Drain is shown on Exhibit B, Drainage Facilities Map. Based on the total project area of 4.9 acres the is tributary to the Line A system, the proposed project must discharge less than 3.8 ft^3/s into the Line A System.

Lateral A is a storm drain that has been designed to collect the outflow discharge that is metered by the two subsurface basins within the high density residential area. The Lateral A Storm Drain will extend from Cypress Avenue to Subsurface Basin B as illustrated in Exhibit B. The Lateral A Storm Drain system will be the main trunk line that collects the flows from the onsite storm drain systems. Table 6 provides the controlled flow rate that will be discharged by the subsurface basins and into Lateral A:

Table 6 – Peak Flow Rate for Basin Outflows into Lateral A

Subsurface Basin	Subareas	Drainage Area (acres)	Allowable Flow Rate (ft^3/s)	Designed Outflow Flow Rate (ft^3/s)
B	**1B, 2B, & 3B**	3.78	2.91	2.8
C	**1C**	1.12	0.86	0.7

Based on Table 6, the flow rate for Lateral A will vary from 2.8 ft^3/s to a maximum of 3.5 ft^3/s which will be conveyed by an 18-inch storm drain system. The maximum flow rate of 3.5 ft^3/s is less than the allowable flow rate of 3.8 ft^3/s, which meets the requirements provided by LACDPW. The 3.5 ft^3/s is the sum of the peak outflow from Basin B and Basin C.

The remaining storm drain shown on Exhibit B provided a horizontal layout to illustrate how proposed catch basins and inlet structures will convey flows to the three proposed subsurface basins. Appendix D provides the calculations for the proposed storm drain based on a full flow rate capacity for an 18-inch and 24-inch storm drain system that uses either HDPE or RCP pipe. Additionally, Appendix E provides calculations for each inlet shown on Exhibit B.

VI. FINDINGS

The hydrology and hydraulic analyses evaluated the proposed development to determine the necessary drainage improvements required to treat for water quality purposes, mitigate flows for increased runoff, and flood protect the project site. It has been concluded that:

1. The proposed drainage facilities will adequately convey the 25-year flows and provide flood protection to the project site.
2. Basin A, B and C have sufficient volume to store the water quality volume and allow the treatment of the water quality volume through infiltration, the preferred Best Management Practice measure.
3. Basin B, and C have been designed to store volume that meter the discharge rate to the allowable flow rate of 0.77 ft^3/s per acre which meets the criteria provided by LACDPW.
4. The post project condition area that flows towards Azusa Avenue is 2.93 acres compared to the 5.64 acres that currently drains to the existing street. The proposed project

condition will reduce the drainage area into Azusa Avenue by 2.71 acres which equates to a flow rate reduction of about 7.8 ft^3/s using a flow rate yield of 2.9 ft^3/s per acre of commercial area.

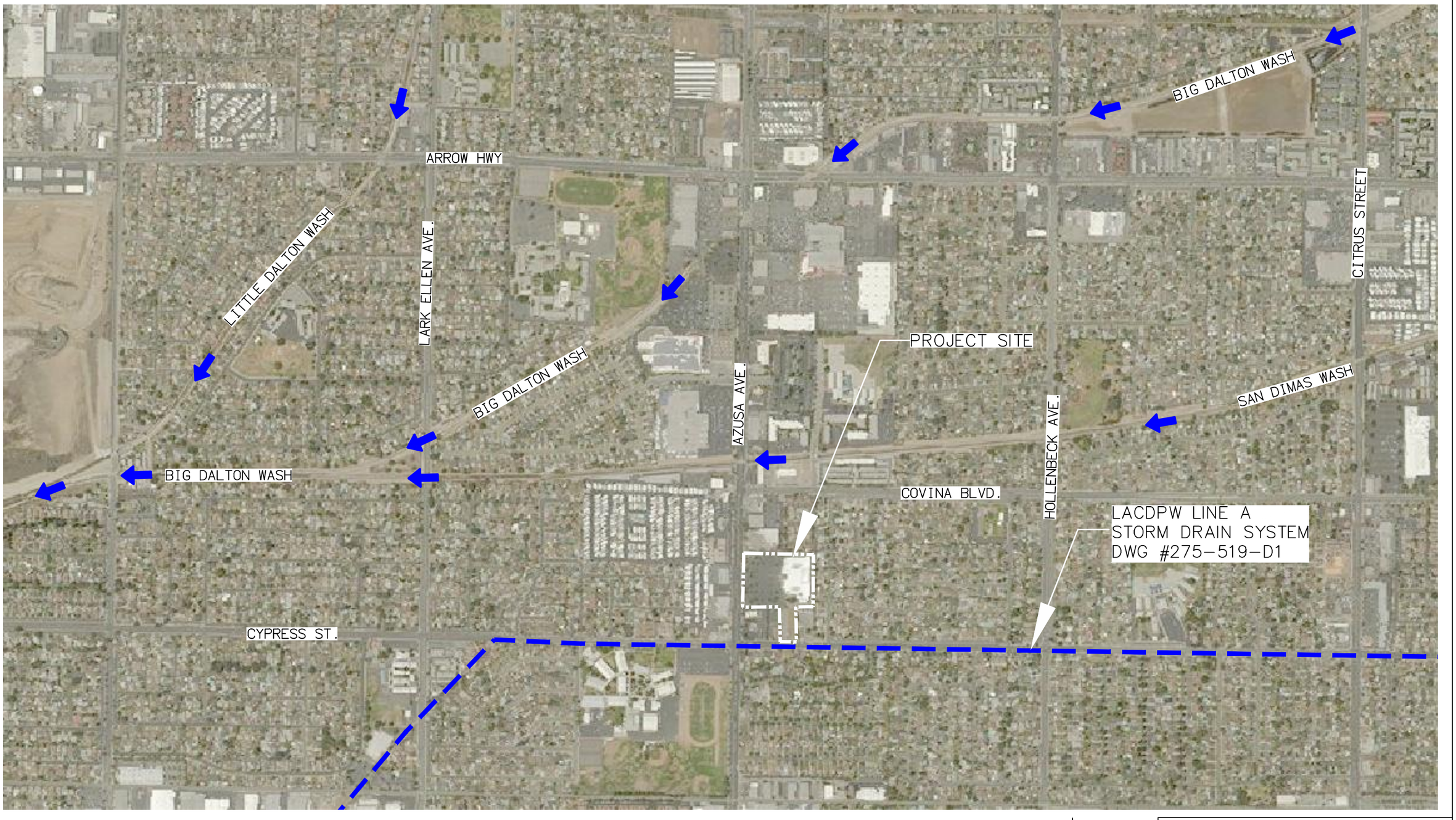
5. Based on the improvement in this report the project will provide the storm drain infrastructure to address water quality and flooding issues for the project site.

VII. REFERENCES

1. Los Angeles County Department of Public Works Manual, January 2006.
2. Los Angeles County Flood Control Design Manual, March 1982

FIGURES

FIGURE 1: VICINITY MAP



TENTAIVE TRACT MAP 82315 VICINITY MAP

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FIGURE 1

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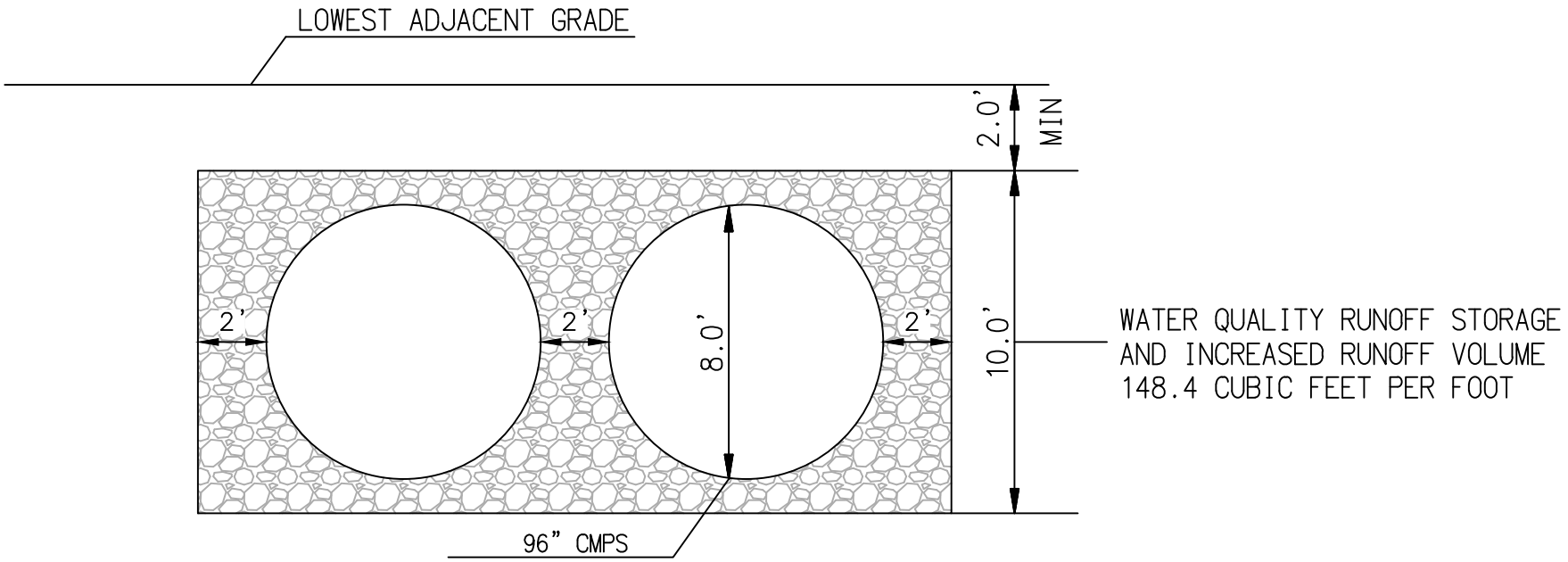
FIGURE 2: DOUBLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

TRACT MAPNO 82315

IN THE CITY OF COVINA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

DOUBLE 96-INCH SUBSURFACE BASIN



DOUBLE SUBSURFACE BASIN - 96" CMP SYSTEM TYPICAL CROSS SECTION

FIGURE 2

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TRACT MAP NO 82315

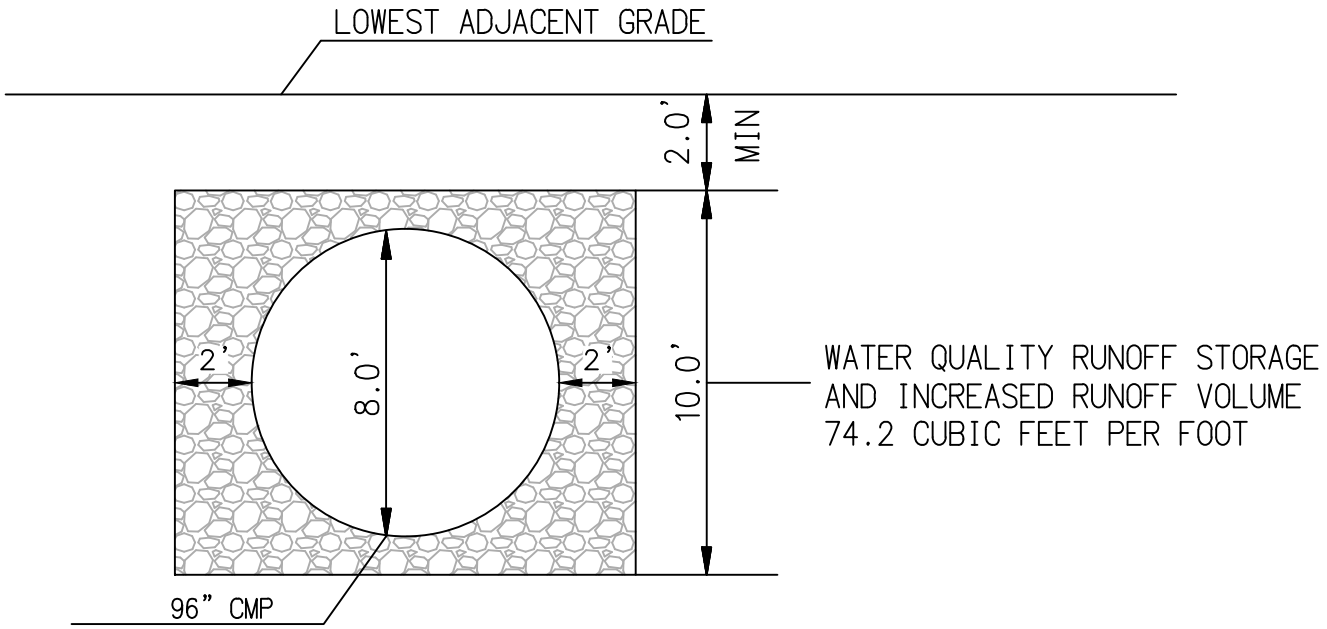
DOUBLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

FIGURE 3: SINGLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

TRACT MAPNO 82315

IN THE CITY OF COVINA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

SINGLE 96-INCH SUBSURFACE BASIN



SINGLE SUBSURFACE BASIN - 96" CMP SYSTEM TYPICAL CROSS SECTION

FIGURE 3

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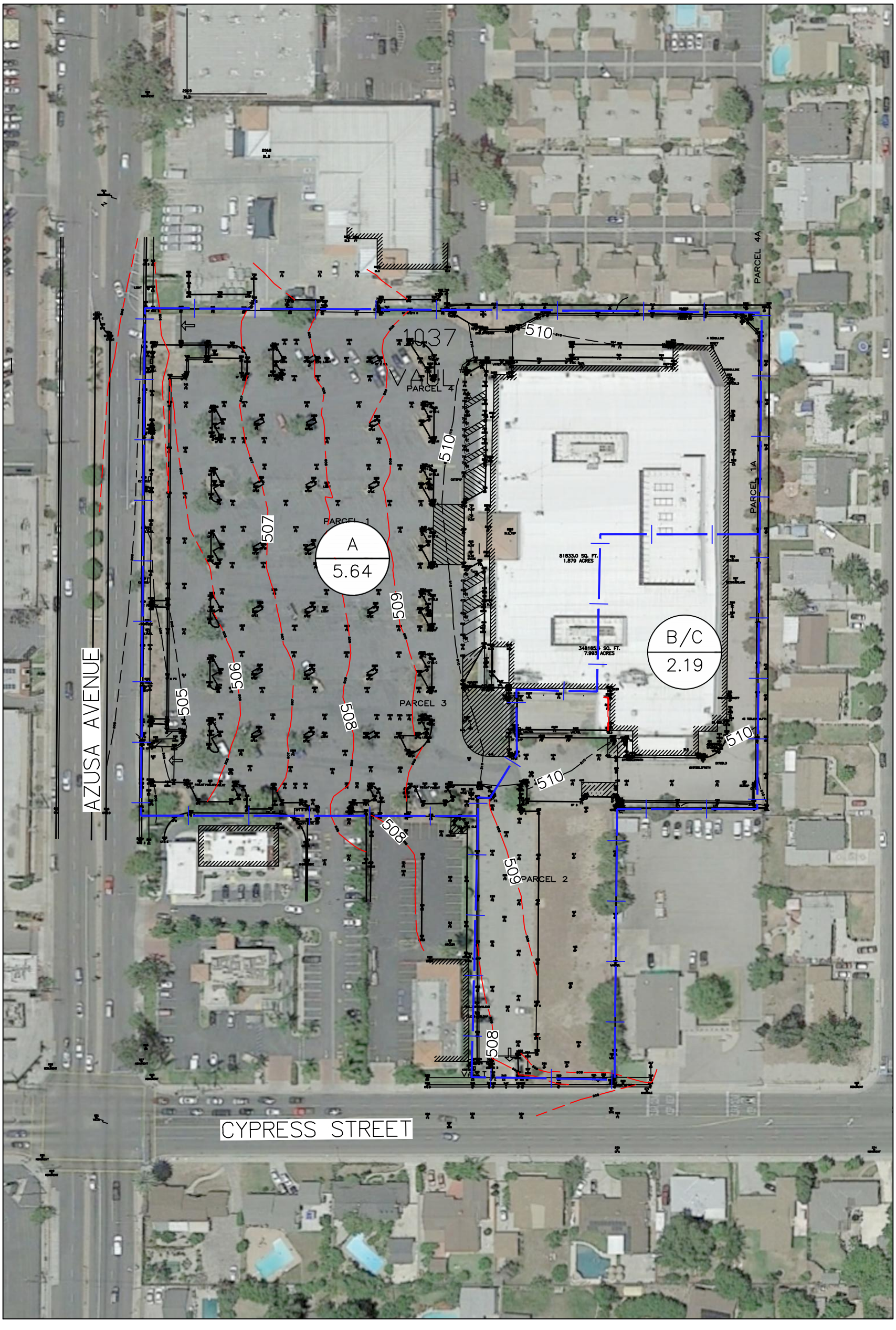
TRACT MAP NO 82315

SINGLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

FIGURE 4: EXISTING CONDITION DRAINAGE MAP

TENTAIVE TRACT MAP 82315
EXISTING DRAINAGE MAP



GRAPHIC SCALE
100' 0 50' 100' 200'
1" = 100'

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FIGURE 3

Drawing Name: O:\205.17.18\Engineering\Hydrology_Plan\Exhibits\Figure\Figure 4-Existing Drainage Area Map.dwg
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APPENDICES

APPENDIX A: CATCH BASINS/INLETS HYDROLOGY

APPENDIX A.1: RATIONAL METHOD ANALYSIS, AREA "1A"

Peak Flow Hydrologic Analysis

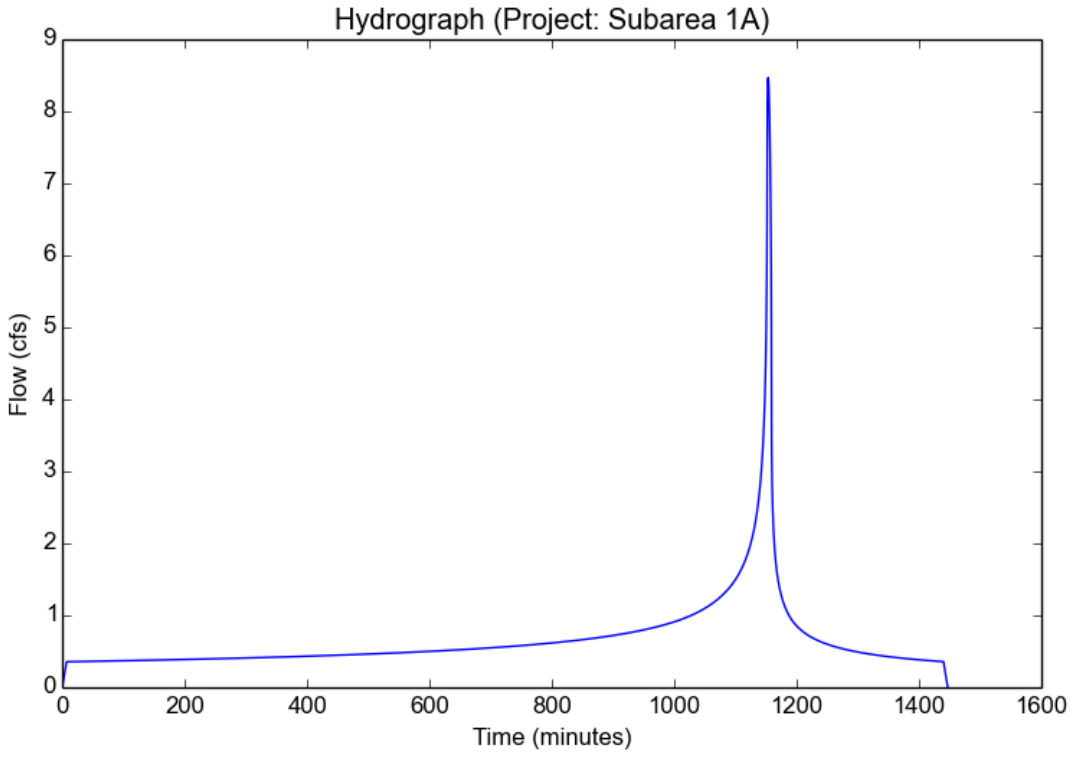
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/Subarea 1A.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	Project
Subarea ID	Subarea 1A
Area (ac)	2.93
Flow Path Length (ft)	613.8
Flow Path Slope (vft/hft)	0.0114
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.96
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.22
Undeveloped Runoff Coefficient (Cu)	0.8377
Developed Runoff Coefficient (Cd)	0.8975
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	8.4675
Burned Peak Flow Rate (cfs)	8.4675
24-Hr Clear Runoff Volume (ac-ft)	1.3363
24-Hr Clear Runoff Volume (cu-ft)	58207.2465



APPENDIX A.2: RATIONAL METHOD ANALYSIS, AREA "1B"

Peak Flow Hydrologic Analysis

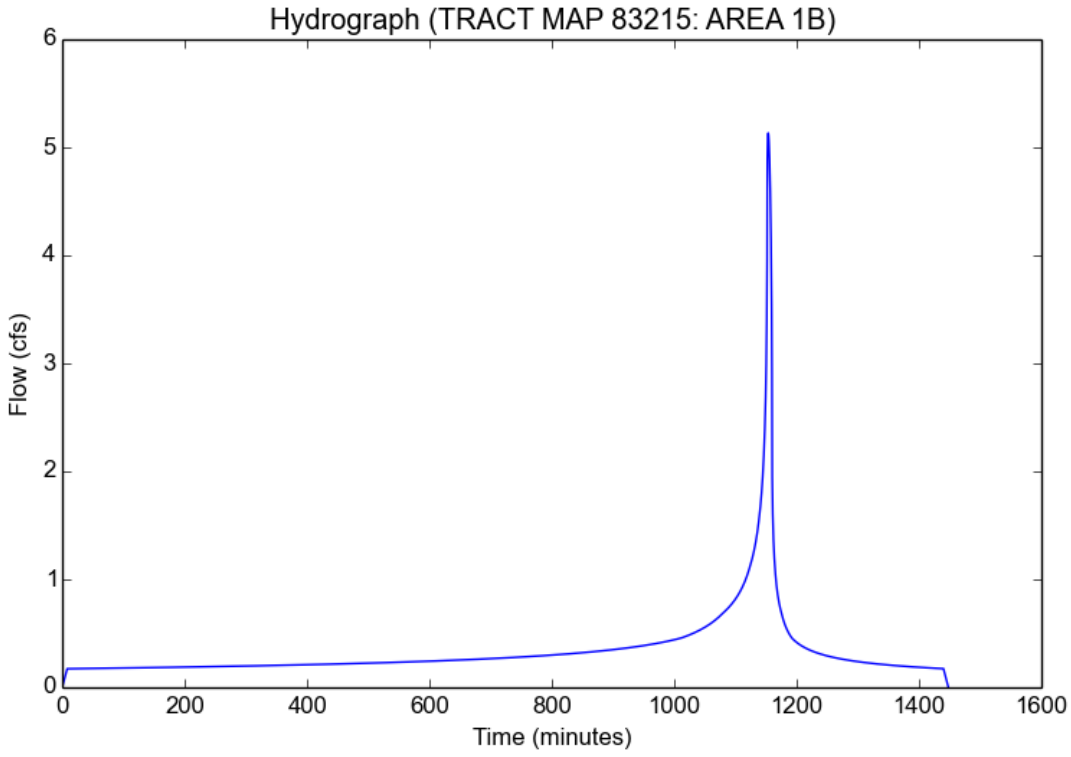
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 1B.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 1B
Area (ac)	1.94
Flow Path Length (ft)	565.6
Flow Path Slope (vft/hft)	0.0056
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.0241
Undeveloped Runoff Coefficient (Cu)	0.824
Developed Runoff Coefficient (Cd)	0.8749
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	5.1329
Burned Peak Flow Rate (cfs)	5.1329
24-Hr Clear Runoff Volume (ac-ft)	0.6858
24-Hr Clear Runoff Volume (cu-ft)	29871.3545



APPENDIX A.3: RATIONAL METHOD ANALYSIS, AREA "2B"

Peak Flow Hydrologic Analysis

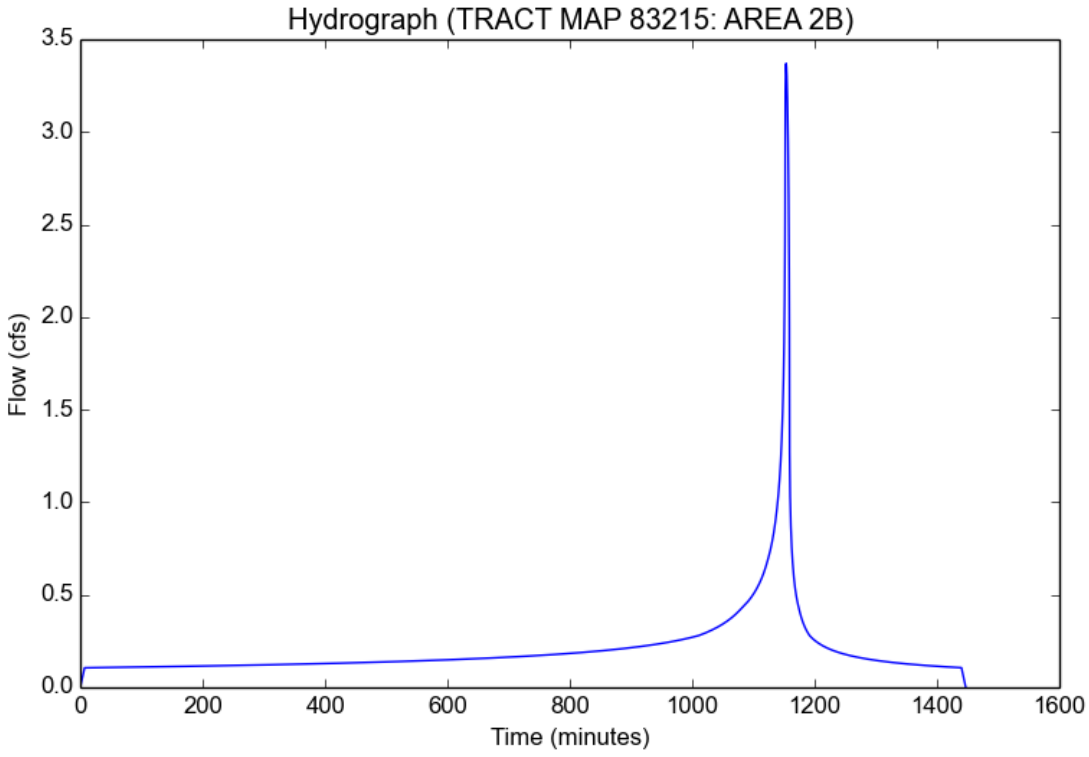
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 2B.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 2B
Area (ac)	1.19
Flow Path Length (ft)	434.5
Flow Path Slope (vft/hft)	0.0061
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.22
Undeveloped Runoff Coefficient (Cu)	0.8377
Developed Runoff Coefficient (Cd)	0.8794
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	3.3698
Burned Peak Flow Rate (cfs)	3.3698
24-Hr Clear Runoff Volume (ac-ft)	0.4207
24-Hr Clear Runoff Volume (cu-ft)	18325.5819



APPENDIX A.4: RATIONAL METHOD ANALYSIS, AREA "3B"

Peak Flow Hydrologic Analysis

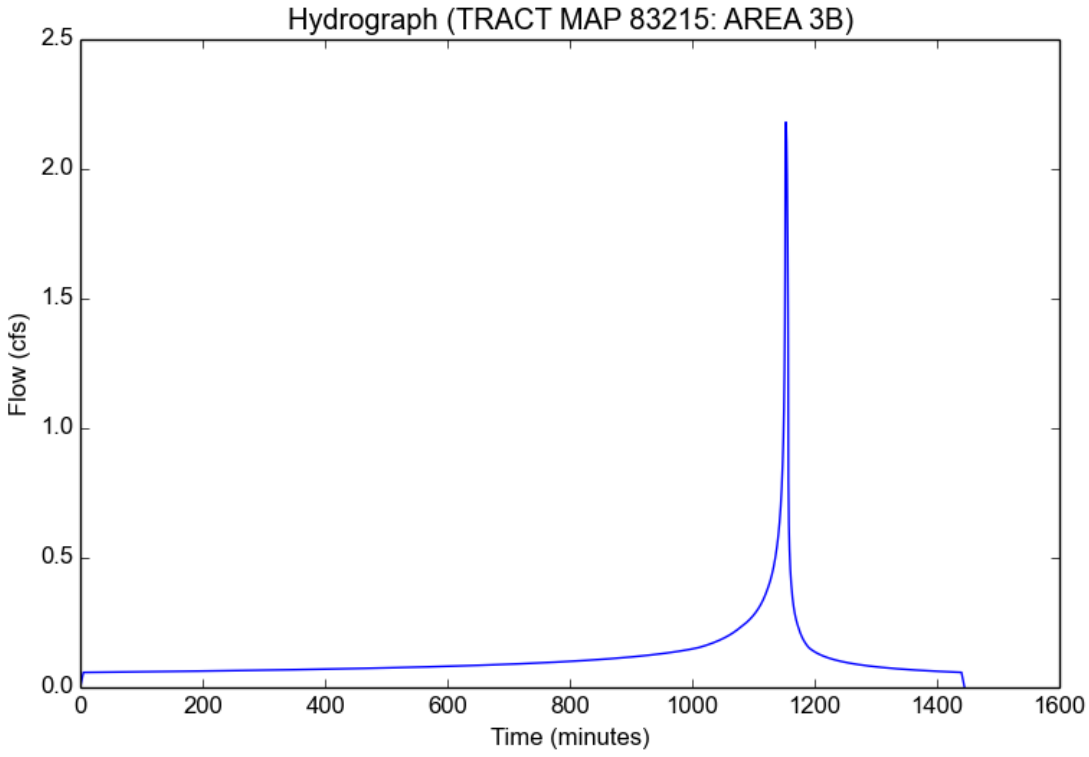
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 3B.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 3B
Area (ac)	0.65
Flow Path Length (ft)	196.3
Flow Path Slope (vft/hft)	0.0082
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.7716
Undeveloped Runoff Coefficient (Cu)	0.8678
Developed Runoff Coefficient (Cd)	0.8894
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.1803
Burned Peak Flow Rate (cfs)	2.1803
24-Hr Clear Runoff Volume (ac-ft)	0.2299
24-Hr Clear Runoff Volume (cu-ft)	10012.5488



APPENDIX A.5: RATIONAL METHOD ANALYSIS, AREA "1C"

Peak Flow Hydrologic Analysis

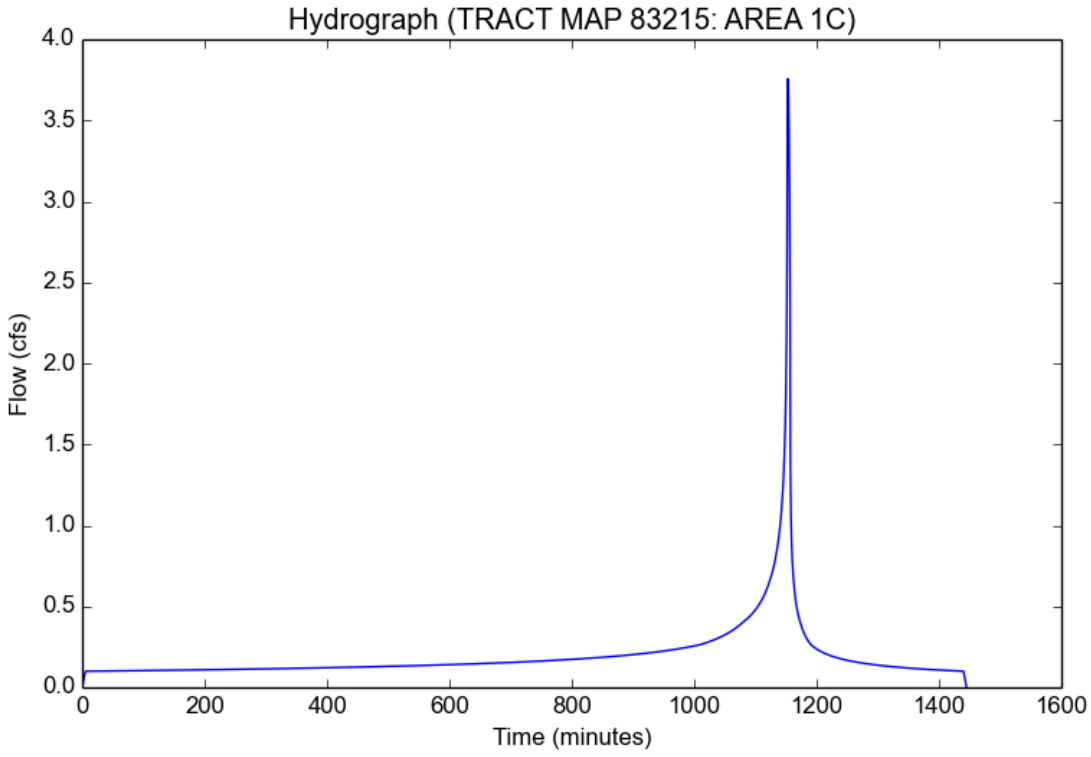
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 1C.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 1C
Area (ac)	1.12
Flow Path Length (ft)	259.6
Flow Path Slope (vft/hft)	0.0069
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.7716
Undeveloped Runoff Coefficient (Cu)	0.8678
Developed Runoff Coefficient (Cd)	0.8894
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	3.7569
Burned Peak Flow Rate (cfs)	3.7569
24-Hr Clear Runoff Volume (ac-ft)	0.3961
24-Hr Clear Runoff Volume (cu-ft)	17252.3918



APPENDIX B: SUBSURFACE BASIN HYDROLOGY

APPENDIX B.1: RATIONAL METHOD ANALYSIS & HYDROGRAPH FOR TO BASIN B

Peak Flow Hydrologic Analysis

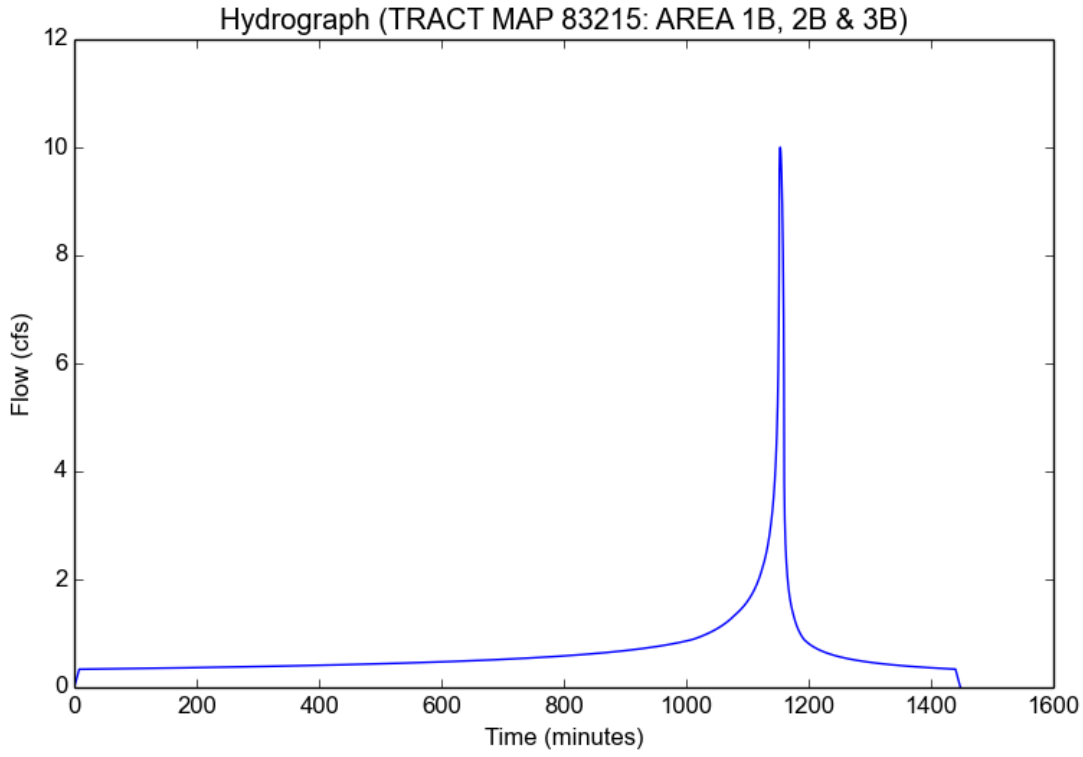
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 1B, 2B & 3B.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 1B, 2B & 3B
Area (ac)	3.78
Flow Path Length (ft)	565.6
Flow Path Slope (vft/hft)	0.0056
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.0241
Undeveloped Runoff Coefficient (Cu)	0.824
Developed Runoff Coefficient (Cd)	0.8749
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	10.0011
Burned Peak Flow Rate (cfs)	10.0011
24-Hr Clear Runoff Volume (ac-ft)	1.3362
24-Hr Clear Runoff Volume (cu-ft)	58202.9485



Inputs: TRACT MAP
83215

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
AREA 1B, 2B & 3B	3.78	565.6	0.0056	7.2	0.67	6	25-yr	0

Outputs: TRACT MAP
83215

Area (ac)	Modeled (25-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
AREA 1B, 2B & 3B	6.3216	8	10.00112792	1.336155842	10.00112792	3.024083983	0.823969416	0.874909907

Hydrograph: TRACT MAP
83215 - AREA 1B, 2B &
3B

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)
0	0	0	0	0	0	0	0	0
30	0.011110116	0.070233708	0.141108083	0.1	0.636	0.339235121	4.070651555	526.4331281
60	0.022360752	0.141355732	0.142910458	0.1	0.636	0.343568174	4.122641309	1140.930294
90	0.033757623	0.21340219	0.144786851	0.1	0.636	0.348079173	4.176765942	1763.385302
120	0.045306842	0.286411733	0.146742518	0.1	0.636	0.352780752	4.233176992	2394.129642
150	0.057014967	0.360425813	0.148783251	0.1	0.636	0.357686839	4.292041563	3033.518686
180	0.068889042	0.435488965	0.15091546	0.1	0.636	0.362812838	4.353544433	3681.934179
210	0.080936654	0.511649149	0.153146249	0.1	0.636	0.368175835	4.417890552	4339.787068
240	0.093165991	0.588958127	0.155483528	0.1	0.636	0.37379484	4.485307961	5007.52075
270	0.105585912	0.6674719	0.157936124	0.1	0.636	0.379691077	4.556051261	5685.614784
300	0.118206026	0.747251215	0.16051393	0.1	0.636	0.385888329	4.630405733	6374.58918
330	0.131036787	0.82836215	0.163228074	0.1	0.636	0.392413348	4.708692276	7075.009363
360	0.144089597	0.910876794	0.166091125	0.1	0.636	0.399296351	4.791273348	7787.491947
390	0.157376937	0.994874044	0.169117343	0.1	0.636	0.406571622	4.878560167	8512.711499
420	0.170912514	1.08044055	0.172322985	0.1	0.636	0.414278243	4.971021507	9251.40849
450	0.184711437	1.16767182	0.175726679	0.1	0.636	0.422460994	5.069194505	10004.39872
480	0.198790426	1.256673558	0.179349888	0.1	0.636	0.431171478	5.173698076	10772.58455
510	0.213168068	1.347563256	0.183217494	0.1	0.636	0.440469514	5.285249685	11556.96838
540	0.227865118	1.440472129	0.187358534	0.1	0.636	0.450424904	5.404686538	12358.66898
570	0.242904879	1.535547483	0.191807134	0.1	0.636	0.461119695	5.532992628	13178.94139
600	0.25831366	1.63295563	0.196603725	0.1	0.636	0.472651083	5.671333657	14019.20147
630	0.27412135	1.732885524	0.201796625	0.1	0.636	0.485135229	5.8211027	14881.05648
660	0.290362147	1.835553348	0.207444139	0.1	0.636	0.498712307	5.983980746	15766.34346
690	0.307075482	1.941208369	0.213617392	0.1	0.636	0.513553301	6.162018227	16677.17835
720	0.324307221	2.050140528	0.220404199	0.1	0.636	0.529869327	6.357746705	17616.01933
750	0.342111242	2.162690426	0.227914483	0.1	0.636	0.547924651	6.574334892	18585.75012
780	0.360551556	2.279262715	0.236288006	0.1	0.636	0.568055271	6.81581145	19589.79133
810	0.379705207	2.400344438	0.245705695	0.1	0.636	0.590696148	7.087391248	20632.25253
840	0.399666339	2.52653073	0.256406712	0.1	0.636	0.616422249	7.395967214	21718.14465
870	0.420552059	2.658561897	0.268715088	0.1	0.636	0.64601257	7.750877412	22853.68521
900	0.442511184	2.7973787	0.283082963	0.1	0.636	0.680554089	8.1651504	24046.7513
930	0.465737814	2.944208163	0.300164278	0.1	0.636	0.721618938	8.657627293	25307.57856
960	0.490493464	3.100703484	0.320948081	0.1	0.636	0.771584863	9.256799291	26649.89311
990	0.517145475	3.269186835	0.347018435	0.1	0.636	0.83426008	10.00828819	28092.85817
1020	0.546239304	3.453106385	0.381113465	0.119094772	0.642301275	0.925304931	11.09853516	29667.0408
1050	0.578650643	3.657997907	0.42850096	0.200514333	0.66916973	1.083876714	12.99866693	31465.1543
1080	0.61596247	3.89386835	0.501107138	0.324143419	0.709967328	1.344809449	16.12610057	33629.04119

1110	0.661693594	4.182962222	0.634829836	0.418582995	0.741132388	1.77846336	21.31539736	36387.36984	
1135.8	0.716523712	4.529576295	0.938100278	0.564087341	0.789148822	2.798336759	33.49042386	39775.96747	
1136	0.717071509	4.53303925	0.942585866	0.565617522	0.789653782	2.813516347	33.67111864	39809.63859	
1136.2	0.717622534	4.53652261	0.947140171	0.567171146	0.790166478	2.828946003	33.8547741	39843.49337	
1136.4	0.718176847	4.540026757	0.951765008	0.56874883	0.790687114	2.844632678	34.04147208	39877.53484	
1136.6	0.718734511	4.543552082	0.956462257	0.570351217	0.791215902	2.860583597	34.23129765	39911.76614	
1136.8	0.719295589	4.547098993	0.961233873	0.571978973	0.791753061	2.876806276	34.42433924	39946.19048	
1137	0.719860147	4.550667907	0.966081885	0.573632789	0.792298821	2.893308535	34.62068887	39980.81117	
1137.2	0.720428255	4.554259257	0.971008403	0.575313387	0.792853418	2.910098511	34.82044227	40015.63161	
1137.4	0.720999983	4.55787349	0.97601562	0.577021514	0.7934171	2.927184684	35.02369917	40050.65531	
1137.6	0.721575403	4.56151107	0.981105819	0.578757949	0.793990123	2.944575886	35.23056342	40085.88587	
1137.8	0.722154593	4.565172473	0.986281374	0.580523501	0.794572755	2.962281327	35.44114328	40121.32701	
1138	0.722737629	4.568858195	0.991544759	0.582319015	0.795165275	2.980310613	35.65555164	40156.98257	
1138.2	0.723324593	4.572568748	0.996898551	0.58414537	0.795767972	2.998673767	35.87390628	40192.85647	
1138.4	0.723915569	4.576304664	1.002345436	0.585635918	0.796259853	3.016921684	36.09357271	40228.95004	
1138.6	0.724510645	4.580066492	1.007888216	0.586658108	0.796597176	3.034889827	36.31086907	40265.26091	
1138.8	0.725109909	4.583854803	1.013529815	0.587698522	0.796940512	3.053192827	36.52849592	40301.78941	
1139	0.725713457	4.587670188	1.019273285	0.588757723	0.797290048	3.07184137	36.75020518	40338.53961	
1139.2	0.726321384	4.591513264	1.025121816	0.589836298	0.797645978	3.090846632	36.97612801	40375.51574	
1139.4	0.726933793	4.595384667	1.031078742	0.590934864	0.798008505	3.11022031	37.20640165	40412.72214	
1139.6	0.727550788	4.599285061	1.037147551	0.592054064	0.798377841	3.129974653	37.44116978	40450.16331	
1139.8	0.728172478	4.603215137	1.043331893	0.593194569	0.798754208	3.150122497	37.6805829	40487.8439	
1140	0.728798977	4.607175613	1.049635592	0.594357086	0.799137838	3.1706773	37.92479878	40525.7687	
1140.2	0.729430403	4.611167236	1.056062656	0.595542354	0.799528977	3.191653187	38.17398292	40563.94268	
1140.4	0.73006688	4.615190785	1.062617288	0.596751148	0.799927879	3.213064989	38.42830906	40602.37099	
1140.6	0.730708535	4.619247074	1.069303899	0.597984281	0.800334813	3.234928292	38.68795969	40641.05895	
1140.8	0.731355503	4.62333695	1.076127123	0.599242608	0.800750061	3.257259489	38.95312669	40680.01207	
1141	0.732007925	4.627461298	1.083091833	0.600527028	0.801173919	3.28007583	39.22401191	40719.23609	
1141.2	0.732665946	4.631621044	1.090203152	0.601838485	0.8016067	3.30339549	39.50082792	40758.73691	
1141.4	0.73332972	4.635817155	1.097466476	0.603177974	0.802048732	3.327237629	39.78379872	40798.52071	
1141.6	0.733999406	4.640050646	1.104887491	0.604546545	0.80250036	3.351622463	40.07316055	40838.59387	
1141.8	0.734675174	4.644322578	1.112472195	0.605945303	0.80296195	3.376571345	40.36916285	40878.96304	
1142	0.735357198	4.648634063	1.120226917	0.607375415	0.803433887	3.402106848	40.67206916	40919.6351	
1142.2	0.736045664	4.652986271	1.12815835	0.608838116	0.803916578	3.428252857	40.98215823	40960.61726	
1142.4	0.736740766	4.657380428	1.136273568	0.61033471	0.804410454	3.455034673	41.29972518	41001.91699	
1142.6	0.737442709	4.661817828	1.144580064	0.61186658	0.804915971	3.482479125	41.62508279	41043.54207	
1142.8	0.738151706	4.666299827	1.15308578	0.613435189	0.805433612	3.510614692	41.9585629	41085.50063	
1143	0.738867986	4.670827861	1.161799144	0.615042093	0.805963891	3.539471637	42.30051797	41127.80115	
1143.2	0.739591787	4.67540344	1.170729108	0.616688941	0.806507351	3.569082164	42.65132281	41170.45247	
1143.4	0.740323361	4.680028162	1.179885194	0.61837749	0.807064572	3.599480576	43.01137644	41213.46385	
1143.6	0.741062977	4.684703716	1.189277544	0.620109611	0.807636172	3.630703466	43.38110425	41256.84496	
1143.8	0.741810917	4.689431892	1.198916972	0.621887298	0.808222808	3.662789918	43.7609603	41300.60592	
1144	0.742567481	4.694214587	1.208815026	0.623712679	0.808825184	3.695781736	44.15142992	41344.75735	
1144.2	0.743332988	4.699053818	1.218984055	0.625588034	0.809444051	3.729723702	44.55303263	41389.31038	
1144.4	0.744107778	4.703951728	1.229437286	0.627515801	0.810080214	3.76466386	44.96632537	41434.2767	
1144.6	0.744892211	4.708910603	1.240188905	0.629498596	0.810734537	3.800653835	45.39190617	41479.66861	
1144.8	0.745686674	4.71393288	1.251254158	0.63153923	0.811407946	3.837749199	45.8304182	41525.49903	
1145	0.746491579	4.719021167	1.262649451	0.63364073	0.812101441	3.876009878	46.28255446	41571.78158	
1145.2	0.747307367	4.724178254	1.274392479	0.635806359	0.812816098	3.915500612	46.74906294	41618.53065	
1145.4	0.748134513	4.729407138	1.28650236	0.638039642	0.813553082	3.956291487	47.23075259	41665.7614	
1145.6	0.748973526	4.734711042	1.298999791	0.640344396	0.814313651	3.998458531	47.72850011	41713.4899	
1145.8	0.749824955	4.740093437	1.311907232	0.642724764	0.815099172	4.042084405	48.24325761	41761.73316	
1146	0.750689394	4.745558076	1.325249108	0.64518525	0.815911132	4.087259192	48.77606158	41810.50922	
1146.2	0.751567486	4.751109022	1.33905205	0.647730764	0.816751152	4.134081311	49.32804302	41859.83726	
1146.4	0.752459929	4.756750686	1.353345168	0.650366676	0.817621003	4.182658579	49.90043934	41909.7377	
1146.6	0.753367482	4.762487875	1.368160372	0.65309887	0.818522627	4.23310944	50.49460812	41960.23231	

REQUIRED STORAGE VOLUME 8,565.2 C.F.

1146.8	0.754290976	4.768325836	1.383532749	0.655933817	0.81945816	4.285564418	51.11204315	42011.34435
1147	0.755231321	4.774270322	1.399501	0.658878654	0.820429956	4.340167815	51.7543934	42063.09874
1147.2	0.756189518	4.780327659	1.416107962	0.661941281	0.821440623	4.39707973	52.42348527	42115.52223
1147.4	0.757166672	4.786504831	1.433401228	0.665130475	0.822493057	4.456478469	53.12134919	42168.64358
1147.6	0.758164006	4.792809581	1.451433894	0.668456028	0.823590489	4.518563429	53.85025139	42222.49383
1147.8	0.759182886	4.799250531	1.470265449	0.67192891	0.82473654	4.583558597	54.61273216	42277.10656
1148	0.760224837	4.805837329	1.489962872	0.675561474	0.825935287	4.651716807	55.41165242	42332.51821
1148.2	0.761291577	4.812580833	1.510601975	0.678576167	0.826930135	4.721833474	56.24130169	42388.75952
1148.4	0.762385049	4.819493327	1.53226906	0.680954325	0.827714927	4.794105859	57.095636	42445.85515
1148.6	0.763507468	4.826588809	1.555063011	0.683456167	0.828540535	4.870275754	57.98628968	42503.84144
1148.8	0.764661374	4.833883341	1.579097934	0.686094217	0.829411092	4.95074667	58.92613454	42562.76758
1149	0.765849707	4.841395506	1.60450656	0.688883043	0.830331404	5.035988861	59.92041319	42622.68799
1149.2	0.767075899	4.849147001	1.63144468	0.691839745	0.831307116	5.126555341	60.97526521	42683.66326
1149.4	0.768343999	4.857163426	1.660097027	0.694984599	0.832344918	5.223103163	62.09795102	42745.76121
1149.6	0.769658843	4.865475345	1.69068524	0.698341932	0.833452838	5.326422232	63.29715237	42809.05836
1149.8	0.771026284	4.874119759	1.723478861	0.701941329	0.834640638	5.437475177	64.58338445	42873.64174
1150	0.772453523	4.883142188	1.758810939	0.705819343	0.835920383	5.557453957	65.96957481	42939.61132
1150.2	0.773949588	4.892599714	1.797100824	0.710022004	0.837307261	5.687862654	67.47189966	43007.08322
1150.4	0.775526067	4.902565586	1.838888684	0.7146086	0.838820838	5.830642993	69.11103388	43076.19425
1150.6	0.777198258	4.913136506	1.88489009	0.71965767	0.840487031	5.988373054	70.91409628	43147.10835
1150.8	0.778987088	4.924444778	1.936087129	0.725277007	0.842341412	6.164599267	72.91783393	43220.02618
1151	0.780922557	4.936680034	1.993891297	0.731621537	0.844435107	6.364430647	75.17417948	43295.20036
1151.2	0.783050462	4.9501318	2.060462702	0.73892835	0.846846356	6.595704347	77.76080996	43372.96117
1151.4	0.785447409	4.965284338	2.139421323	0.747594773	0.849706275	6.871585351	80.80373819	43453.76491
1151.6	0.788261517	4.983074007	2.237777184	0.758390217	0.853268772	7.217627971	84.53527994	43538.30019
1151.8	0.791870458	5.005888288	2.373422976	0.773278569	0.858181928	7.699212503	89.50104284	43627.80123
1152	0.8	5.05728	2.722990599	0.802828536	0.867933417	8.933555739	99.79660945	43727.59784
1152.2	0.804237385	5.08406705	2.887599243	0.814386317	0.871747485	9.515232883	110.6927317	43838.29057
1152.4	0.806118483	5.095958603	2.940051565	0.818069189	0.872962832	9.701580702	115.3008815	43953.59145
1152.6	0.807585289	5.105231164	2.972404206	0.820340787	0.87371246	9.816760513	117.1100473	44070.7015
1152.8	0.808834657	5.113129165	2.993972134	0.821855151	0.8742122	9.893647129	118.2624459	44188.96395
1153	0.809943791	5.120140668	3.008396257	0.822867922	0.874546414	9.945112564	119.0325582	44307.99651
1153.2	0.81095262	5.126518085	3.017548735	0.823510552	0.874758482	9.977787608	119.537401	44427.53391
1153.4	0.811885018	5.132412328	3.022538926	0.823860931	0.874874107	9.99560915	119.8403805	44547.37429
1153.6	0.812756619	5.13792224	3.024083983	0.823969416	0.874909907	10.00112792	119.9804224	44667.35471
1153.8	0.813578331	5.14311678	3.022675071	0.823870491	0.874877262	9.996095428	119.9833401	44787.33805
1154	0.81435813	5.148046353	3.01866208	0.823588724	0.874784279	9.981763333	119.8671526	44907.2052
1154.2	0.815102053	5.15274914	3.012300888	0.823142081	0.874636887	9.959050597	119.6448836	45026.85009
1154.4	0.815814808	5.157254893	3.00378155	0.822543907	0.874439489	9.928643273	119.3261632	45146.17625
1154.6	0.816500148	5.161587338	2.993245978	0.821804165	0.874195374	9.891057161	118.9182026	45265.09445
1154.8	0.817161124	5.165765763	2.980799451	0.820930248	0.873906982	9.846678688	118.4264151	45383.52087
1155	0.817800256	5.169806097	2.966518313	0.819927517	0.873576081	9.795792286	117.8548258	45501.37569
1155.2	0.818419654	5.173721684	2.950455192	0.818799666	0.87320389	9.738599031	117.2063479	45618.58204
1155.4	0.819021108	5.177523834	2.932642526	0.817548973	0.872791161	9.675229315	116.4829701	45735.06501
1155.6	0.819606149	5.181222233	2.91309489	0.816176461	0.872338232	9.605751295	115.6858837	45850.75089
1155.8	0.820176103	5.184825252	2.891810409	0.814681999	0.87184506	9.530176139	114.8155646	45965.56646
1156	0.820732123	5.188340187	2.868771436	0.813064347	0.871311235	9.448460715	113.8718211	46079.43828
1156.2	0.821275222	5.191773444	2.843944582	0.811321162	0.870735983	9.360508056	112.8538126	46192.29209
1156.4	0.821806296	5.195130678	2.817280138	0.809448953	0.870118154	9.266165725	111.7600427	46304.05214
1156.6	0.822326139	5.198416921	2.788710845	0.807442997	0.869456189	9.165221995	110.5883263	46414.64046
1156.8	0.822835464	5.201636667	2.758149943	0.805297203	0.868748077	9.057399597	109.3357295	46523.97619
1157	0.823334907	5.20479395	2.72548833	0.803003911	0.86799129	8.942346501	107.9984766	46631.97467
1157.2	0.823825046	5.207892411	2.690590577	0.80055361	0.867182691	8.819622925	106.5718166	46738.54648
1157.4	0.824306402	5.210935349	2.653289422	0.797934558	0.866318404	8.68868327	105.0498372	46843.59632
1157.6	0.824779448	5.21392576	2.613378113	0.795132238	0.865393638	8.548851001	103.4252056	46947.02153
1157.8	0.825244619	5.216866381	2.570599665	0.792128605	0.864402439	8.399283307	101.6888058	47048.71033

1158	0.825702309	5.219759716	2.524631462	0.788901007	0.863337332	8.238920475	99.8292227	47148.53956
1158.2	0.826152883	5.222608066	2.47506264	0.78443444	0.861863365	8.063366786	97.81372357	47246.35328
1158.4	0.826596676	5.225413547	2.421359708	0.778540058	0.859918219	7.87060762	95.60384644	47341.95713
1158.6	0.827033997	5.228178116	2.362812074	0.772113926	0.857797596	7.661358871	93.19179895	47435.14892
1158.8	0.827465133	5.230903583	2.298441034	0.765048623	0.855466046	7.432380632	90.56243702	47525.71136
1159	0.827890348	5.233591626	2.22683694	0.757189427	0.852872511	7.179006287	87.66832151	47613.37968
1159.2	0.828309891	5.236243808	2.145840059	0.748299287	0.849938765	6.894087414	84.43856221	47697.81825
1159.4	0.828723991	5.238861584	2.051829346	0.737980762	0.846533651	6.565642983	80.75838238	47778.57663
1159.6	0.829132864	5.241446313	1.937792294	0.725464165	0.842403174	6.170480995	76.41674386	47854.99337
1159.8	0.82953671	5.243999265	1.785832325	0.708785185	0.836899111	5.649442413	70.91954044	47925.91291
1160	0.829935717	5.246521631	1.419312233	0.662532207	0.821635628	4.408075344	60.34510654	47986.25802
1160.2	0.830330063	5.249014529	1.237106094	0.628930069	0.810546923	3.790328992	49.19042602	48035.44844
1160.4	0.830719914	5.25147901	1.166403047	0.615891136	0.806244075	3.554732964	44.07037174	48079.51882
1160.6	0.831105426	5.253916062	1.115136738	0.606436693	0.803124109	3.385342293	41.64045154	48121.15927
1160.8	0.831486747	5.256326619	1.073980909	0.598846807	0.800619446	3.250233003	39.81345177	48160.97272
1161	0.831864016	5.258711562	1.039281704	0.59244764	0.798507721	3.136925479	38.32295089	48199.29567
1161.2	0.832237364	5.261071722	1.009152271	0.586891223	0.796674104	3.038989518	37.05548998	48236.35116
1161.4	0.832606917	5.263407887	0.982466691	0.579222187	0.794143322	2.949229186	35.92931222	48272.28047
1161.6	0.832972793	5.265720806	0.958489245	0.57104269	0.791444088	2.867472643	34.90021097	48307.18068
1161.8	0.833335103	5.268011185	0.936708039	0.563612402	0.788992093	2.793628792	33.96660861	48341.14729
1170	0.846009383	5.348132913	0.583899103	0.382613957	0.729262606	1.609583653	19.39623054	49348.92769
1200	0.877376634	5.546424129	0.337907571	0.1	0.636	0.812356832	9.758772659	51301.85827
1230	0.900083415	5.689967317	0.264492571	0.1	0.636	0.6358613	7.635198535	52585.05043
1260	0.918923195	5.809064868	0.225358767	0.1	0.636	0.541780505	6.504310481	53637.87278
1290	0.935421585	5.913361093	0.200037506	0.1	0.636	0.480906166	5.77290122	54554.89015
1320	0.950302393	6.00743161	0.181911124	0.1	0.636	0.437328895	5.24945251	55379.36101
1350	0.963977601	6.093880802	0.168097231	0.1	0.636	0.404119191	4.850606295	56135.43438
1380	0.976708502	6.174360468	0.157110601	0.1	0.636	0.377706453	4.533429223	56838.24017
1410	0.988673289	6.249997067	0.148097138	0.1	0.636	0.356037368	4.273239538	57498.00915
1440	1	6.3216	0.140525911	0.1	0.636	0.337835533	4.054697724	58122.04674

APPENDIX B.2: RATIONAL METHOD ANALYSIS & HYDROGRAPH FOR TO BASIN C

Peak Flow Hydrologic Analysis

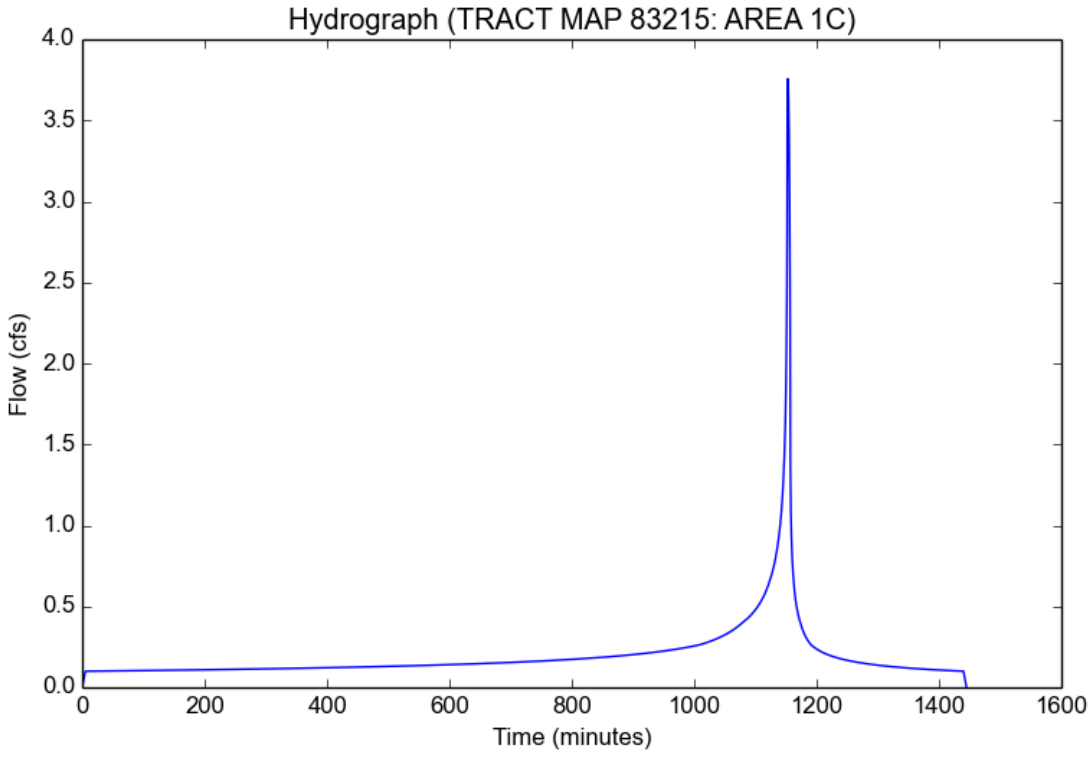
File location: O:/205.17.18/Engineering/Hydrology_Plan/Calcs/25 YR/TRACT MAP 83215 - AREA 1C.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	TRACT MAP 83215
Subarea ID	AREA 1C
Area (ac)	1.12
Flow Path Length (ft)	259.6
Flow Path Slope (vft/hft)	0.0069
50-yr Rainfall Depth (in)	7.2
Percent Impervious	0.67
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	6.3216
Peak Intensity (in/hr)	3.7716
Undeveloped Runoff Coefficient (Cu)	0.8678
Developed Runoff Coefficient (Cd)	0.8894
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	3.7569
Burned Peak Flow Rate (cfs)	3.7569
24-Hr Clear Runoff Volume (ac-ft)	0.3961
24-Hr Clear Runoff Volume (cu-ft)	17252.3918



Inputs: TRACT MAP
83215

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
AREA 1C	1.12	259.6	0.0069	7.2	0.67	6	25-yr	0

Outputs: TRACT MAP
83215

Area (ac)	Modeled (25-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
AREA 1C	6.3216	5	3.756878195	0.396060418	3.756878195	3.77164006	0.867765391	0.889362579

Hydrograph: TRACT MAP
83215 - AREA 1C

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.00	0.01	0.07	0.14	0.10	0.64	0.10	1.21	165.02
60.00	0.02	0.14	0.14	0.10	0.64	0.10	1.22	347.21
90.00	0.03	0.21	0.14	0.10	0.64	0.10	1.24	531.76
120.00	0.05	0.29	0.15	0.10	0.64	0.10	1.26	718.77
150.00	0.06	0.36	0.15	0.10	0.64	0.11	1.27	908.35
180.00	0.07	0.44	0.15	0.10	0.64	0.11	1.29	1100.61
210.00	0.08	0.51	0.15	0.10	0.64	0.11	1.31	1295.67
240.00	0.09	0.59	0.16	0.10	0.64	0.11	1.33	1493.67
270.00	0.11	0.67	0.16	0.10	0.64	0.11	1.35	1694.74
300.00	0.12	0.75	0.16	0.10	0.64	0.11	1.37	1899.05
330.00	0.13	0.83	0.16	0.10	0.64	0.12	1.40	2106.75
360.00	0.14	0.91	0.17	0.10	0.64	0.12	1.42	2318.04
390.00	0.16	0.99	0.17	0.10	0.64	0.12	1.45	2533.12
420.00	0.17	1.08	0.17	0.10	0.64	0.12	1.47	2752.20
450.00	0.18	1.17	0.18	0.10	0.64	0.13	1.50	2975.52
480.00	0.20	1.26	0.18	0.10	0.64	0.13	1.53	3203.36
510.00	0.21	1.35	0.18	0.10	0.64	0.13	1.57	3436.02
540.00	0.23	1.44	0.19	0.10	0.64	0.13	1.60	3673.83
570.00	0.24	1.54	0.19	0.10	0.64	0.14	1.64	3917.16
600.00	0.26	1.63	0.20	0.10	0.64	0.14	1.68	4166.43
630.00	0.27	1.73	0.20	0.10	0.64	0.14	1.73	4422.13
660.00	0.29	1.84	0.21	0.10	0.64	0.15	1.78	4684.80
690.00	0.31	1.94	0.21	0.10	0.64	0.15	1.83	4955.07
720.00	0.32	2.05	0.22	0.10	0.64	0.16	1.89	5233.68
750.00	0.34	2.16	0.23	0.10	0.64	0.16	1.95	5521.49
780.00	0.36	2.28	0.24	0.10	0.64	0.17	2.02	5819.52
810.00	0.38	2.40	0.25	0.10	0.64	0.18	2.10	6129.00
840.00	0.40	2.53	0.26	0.10	0.64	0.18	2.20	6451.43
870.00	0.42	2.66	0.27	0.10	0.64	0.19	2.30	6788.67
900.00	0.44	2.80	0.28	0.10	0.64	0.20	2.43	7143.09
930.00	0.47	2.94	0.30	0.10	0.64	0.21	2.57	7517.76
960.00	0.49	3.10	0.32	0.10	0.64	0.23	2.75	7916.82
990.00	0.52	3.27	0.35	0.10	0.64	0.25	2.98	8346.03
1020.00	0.55	3.45	0.38	0.12	0.64	0.28	3.31	8814.89
1050.00	0.58	3.66	0.43	0.21	0.67	0.32	3.89	9351.88
1080.00	0.62	3.89	0.51	0.33	0.71	0.40	4.83	9999.93
1110.00	0.66	4.18	0.64	0.43	0.74	0.54	6.43	10828.68

1126.80	0.69	4.39	0.81	0.52	0.77	0.70	8.37	11442.59	REQUIRED STORAGE VOLUME 2,961.7 C.F.
1127.00	0.69	4.39	0.81	0.52	0.77	0.70	8.40	11450.99	
1127.20	0.70	4.40	0.81	0.52	0.77	0.70	8.43	11459.42	
1127.40	0.70	4.40	0.81	0.52	0.78	0.71	8.47	11467.89	
1127.60	0.70	4.40	0.82	0.52	0.78	0.71	8.50	11476.39	
1127.80	0.70	4.40	0.82	0.52	0.78	0.71	8.53	11484.92	
1128.00	0.70	4.41	0.82	0.52	0.78	0.72	8.57	11493.49	
1128.20	0.70	4.41	0.83	0.53	0.78	0.72	8.60	11502.09	
1128.40	0.70	4.41	0.83	0.53	0.78	0.72	8.64	11510.72	
1128.60	0.70	4.42	0.83	0.53	0.78	0.72	8.67	11519.39	
1128.80	0.70	4.42	0.83	0.53	0.78	0.73	8.71	11528.10	
1129.00	0.70	4.42	0.84	0.53	0.78	0.73	8.74	11536.84	
1129.20	0.70	4.42	0.84	0.53	0.78	0.73	8.78	11545.62	
1129.40	0.70	4.43	0.84	0.53	0.78	0.74	8.81	11554.43	
1129.60	0.70	4.43	0.85	0.53	0.78	0.74	8.85	11563.28	
1129.80	0.70	4.43	0.85	0.53	0.78	0.74	8.89	11572.17	
1130.00	0.70	4.44	0.85	0.54	0.78	0.75	8.93	11581.10	
1130.20	0.70	4.44	0.86	0.54	0.78	0.75	8.97	11590.07	
1130.40	0.70	4.44	0.86	0.54	0.78	0.75	9.01	11599.08	
1130.60	0.70	4.45	0.86	0.54	0.78	0.76	9.05	11608.12	
1130.80	0.70	4.45	0.87	0.54	0.78	0.76	9.09	11617.21	
1131.00	0.70	4.45	0.87	0.54	0.78	0.76	9.13	11626.33	
1131.20	0.70	4.45	0.87	0.54	0.78	0.77	9.17	11635.50	
1131.40	0.71	4.46	0.88	0.54	0.78	0.77	9.21	11644.71	
1131.60	0.71	4.46	0.88	0.54	0.78	0.77	9.25	11653.97	
1131.80	0.71	4.46	0.89	0.55	0.78	0.78	9.30	11663.26	
1132.00	0.71	4.47	0.89	0.55	0.78	0.78	9.34	11672.60	
1132.20	0.71	4.47	0.89	0.55	0.78	0.78	9.38	11681.99	
1132.40	0.71	4.47	0.90	0.55	0.78	0.79	9.43	11691.42	
1132.60	0.71	4.48	0.90	0.55	0.78	0.79	9.48	11700.89	
1132.80	0.71	4.48	0.90	0.55	0.79	0.80	9.52	11710.41	
1133.00	0.71	4.48	0.91	0.55	0.79	0.80	9.57	11719.98	
1133.20	0.71	4.49	0.91	0.56	0.79	0.80	9.62	11729.60	
1133.40	0.71	4.49	0.92	0.56	0.79	0.81	9.66	11739.26	
1133.60	0.71	4.49	0.92	0.56	0.79	0.81	9.71	11748.98	
1133.80	0.71	4.50	0.92	0.56	0.79	0.82	9.76	11758.74	
1134.00	0.71	4.50	0.93	0.56	0.79	0.82	9.81	11768.55	
1134.20	0.71	4.50	0.93	0.56	0.79	0.82	9.87	11778.42	
1134.40	0.71	4.51	0.94	0.56	0.79	0.83	9.92	11788.34	
1134.60	0.71	4.51	0.94	0.57	0.79	0.83	9.97	11798.31	
1134.80	0.71	4.51	0.95	0.57	0.79	0.84	10.03	11808.33	
1135.00	0.71	4.52	0.95	0.57	0.79	0.84	10.08	11818.41	
1135.20	0.71	4.52	0.96	0.57	0.79	0.85	10.14	11828.55	
1135.40	0.72	4.52	0.96	0.57	0.79	0.85	10.19	11838.74	
1135.60	0.72	4.53	0.97	0.57	0.79	0.86	10.25	11848.99	
1135.80	0.72	4.53	0.97	0.58	0.79	0.86	10.31	11859.30	
1136.00	0.72	4.53	0.98	0.58	0.79	0.87	10.37	11869.67	
1136.20	0.72	4.54	0.98	0.58	0.79	0.87	10.43	11880.10	
1136.40	0.72	4.54	0.99	0.58	0.79	0.88	10.49	11890.59	
1136.60	0.72	4.54	0.99	0.58	0.80	0.88	10.55	11901.15	
1136.80	0.72	4.55	1.00	0.58	0.80	0.89	10.62	11911.76	
1137.00	0.72	4.55	1.00	0.59	0.80	0.89	10.68	11922.45	
1137.20	0.72	4.55	1.01	0.59	0.80	0.90	10.75	11933.19	
1137.40	0.72	4.56	1.01	0.59	0.80	0.90	10.81	11944.00	
1137.60	0.72	4.56	1.02	0.59	0.80	0.91	10.88	11954.88	
1137.80	0.72	4.57	1.02	0.59	0.80	0.91	10.94	11965.82	

1138.00	0.72	4.57	1.03	0.59	0.80	0.92	11.01	11976.83
1138.20	0.72	4.57	1.04	0.59	0.80	0.93	11.08	11987.91
1138.40	0.72	4.58	1.04	0.59	0.80	0.93	11.15	11999.05
1138.60	0.72	4.58	1.05	0.59	0.80	0.94	11.22	12010.27
1138.80	0.73	4.58	1.05	0.60	0.80	0.94	11.29	12021.56
1139.00	0.73	4.59	1.06	0.60	0.80	0.95	11.37	12032.93
1139.20	0.73	4.59	1.07	0.60	0.80	0.96	11.44	12044.37
1139.40	0.73	4.60	1.07	0.60	0.80	0.96	11.52	12055.89
1139.60	0.73	4.60	1.08	0.60	0.80	0.97	11.60	12067.49
1140.00	0.73	4.61	1.10	0.60	0.80	0.98	11.76	12090.92
1140.20	0.73	4.61	1.10	0.60	0.80	0.99	11.84	12102.77
1140.40	0.73	4.62	1.11	0.61	0.80	1.00	11.93	12114.70
1140.60	0.73	4.62	1.12	0.61	0.80	1.01	12.02	12126.72
1140.80	0.73	4.62	1.13	0.61	0.80	1.01	12.11	12138.83
1141.00	0.73	4.63	1.13	0.61	0.80	1.02	12.20	12151.03
1141.20	0.73	4.63	1.14	0.61	0.80	1.03	12.29	12163.32
1141.40	0.73	4.64	1.15	0.61	0.81	1.04	12.39	12175.71
1141.60	0.73	4.64	1.16	0.61	0.81	1.04	12.49	12188.20
1141.80	0.73	4.64	1.17	0.62	0.81	1.05	12.59	12200.79
1142.00	0.74	4.65	1.18	0.62	0.81	1.06	12.69	12213.49
1142.20	0.74	4.65	1.18	0.62	0.81	1.07	12.80	12226.29
1142.40	0.74	4.66	1.19	0.62	0.81	1.08	12.91	12239.20
1142.60	0.74	4.66	1.20	0.62	0.81	1.09	13.02	12252.22
1142.80	0.74	4.67	1.21	0.62	0.81	1.10	13.14	12265.36
1143.00	0.74	4.67	1.22	0.63	0.81	1.11	13.26	12278.62
1143.20	0.74	4.68	1.23	0.63	0.81	1.12	13.38	12292.00
1143.40	0.74	4.68	1.24	0.63	0.81	1.13	13.50	12305.50
1143.60	0.74	4.68	1.26	0.63	0.81	1.14	13.63	12319.13
1143.80	0.74	4.69	1.27	0.63	0.81	1.15	13.77	12332.90
1144.00	0.74	4.69	1.28	0.64	0.81	1.16	13.90	12346.80
1144.20	0.74	4.70	1.29	0.64	0.81	1.18	14.04	12360.84
1144.40	0.74	4.70	1.30	0.64	0.81	1.19	14.19	12375.03
1144.60	0.74	4.71	1.32	0.64	0.82	1.20	14.34	12389.37
1144.80	0.75	4.71	1.33	0.65	0.82	1.21	14.49	12403.86
1145.00	0.75	4.72	1.34	0.65	0.82	1.23	14.65	12418.52
1145.20	0.75	4.72	1.36	0.65	0.82	1.24	14.82	12433.34
1145.40	0.75	4.73	1.37	0.65	0.82	1.26	14.99	12448.33
1145.60	0.75	4.73	1.39	0.66	0.82	1.27	15.17	12463.50
1145.80	0.75	4.74	1.40	0.66	0.82	1.29	15.36	12478.86
1146.00	0.75	4.75	1.42	0.66	0.82	1.30	15.55	12494.41
1146.20	0.75	4.75	1.43	0.67	0.82	1.32	15.75	12510.16
1146.40	0.75	4.76	1.45	0.67	0.82	1.34	15.96	12526.11
1146.60	0.75	4.76	1.47	0.67	0.82	1.36	16.17	12542.29
1146.80	0.75	4.77	1.49	0.68	0.83	1.38	16.40	12558.69
1147.00	0.76	4.77	1.51	0.68	0.83	1.40	16.63	12575.32
1147.20	0.76	4.78	1.53	0.68	0.83	1.42	16.87	12592.20
1147.40	0.76	4.79	1.55	0.68	0.83	1.44	17.12	12609.32
1147.60	0.76	4.79	1.57	0.69	0.83	1.46	17.38	12626.70
1147.80	0.76	4.80	1.60	0.69	0.83	1.48	17.66	12644.36
1148.00	0.76	4.81	1.62	0.69	0.83	1.51	17.94	12662.31
1148.20	0.76	4.81	1.65	0.69	0.83	1.53	18.25	12680.55
1148.40	0.76	4.82	1.67	0.70	0.83	1.56	18.57	12699.12
1148.60	0.76	4.83	1.70	0.70	0.83	1.59	18.91	12718.03
1148.80	0.76	4.83	1.73	0.70	0.84	1.62	19.27	12737.30
1149.00	0.77	4.84	1.77	0.71	0.84	1.65	19.65	12756.95
1149.20	0.77	4.85	1.80	0.71	0.84	1.69	20.06	12777.01

1149.40	0.77	4.86	1.84	0.71	0.84	1.73	20.50	12797.51
1149.60	0.77	4.87	1.88	0.72	0.84	1.77	20.97	12818.48
1149.80	0.77	4.87	1.92	0.72	0.84	1.81	21.48	12839.96
1150.00	0.77	4.88	1.97	0.73	0.84	1.86	22.04	12862.00
1150.20	0.77	4.89	2.02	0.73	0.85	1.91	22.65	12884.65
1150.40	0.78	4.90	2.08	0.74	0.85	1.97	23.32	12907.96
1150.60	0.78	4.91	2.14	0.75	0.85	2.04	24.06	12932.02
1150.80	0.78	4.92	2.21	0.76	0.85	2.11	24.90	12956.92
1151.00	0.78	4.94	2.29	0.76	0.86	2.20	25.85	12982.78
1151.20	0.78	4.95	2.39	0.77	0.86	2.30	26.96	13009.74
1151.40	0.79	4.97	2.50	0.79	0.86	2.42	28.29	13038.03
1151.60	0.79	4.98	2.65	0.80	0.87	2.57	29.92	13067.95
1151.80	0.79	5.01	2.85	0.81	0.87	2.78	32.09	13100.04
1152.00	0.80	5.06	3.40	0.85	0.88	3.36	36.85	13136.89
1152.20	0.80	5.08	3.64	0.86	0.89	3.62	41.91	13178.79
1152.40	0.81	5.10	3.71	0.87	0.89	3.70	43.92	13222.71
1152.60	0.81	5.11	3.75	0.87	0.89	3.73	44.57	13267.29
1152.80	0.81	5.11	3.77	0.87	0.89	3.75	44.91	13312.20
1153.00	0.81	5.12	3.77	0.87	0.89	3.76	45.05	13357.25
1153.20	0.81	5.13	3.77	0.87	0.89	3.75	45.05	13402.30
1153.40	0.81	5.13	3.76	0.87	0.89	3.74	44.95	13447.25
1153.60	0.81	5.14	3.74	0.87	0.89	3.72	44.75	13492.01
1153.80	0.81	5.14	3.71	0.87	0.89	3.69	44.48	13536.48
1154.00	0.81	5.15	3.68	0.86	0.89	3.66	44.12	13580.60
1154.20	0.82	5.15	3.64	0.86	0.89	3.62	43.70	13624.30
1154.40	0.82	5.16	3.60	0.86	0.89	3.58	43.20	13667.51
1154.60	0.82	5.16	3.55	0.86	0.89	3.53	42.64	13710.15
1154.80	0.82	5.17	3.50	0.86	0.89	3.47	42.01	13752.15
1155.00	0.82	5.17	3.44	0.85	0.88	3.41	41.28	13793.44
1155.20	0.82	5.17	3.37	0.85	0.88	3.34	40.47	13833.90
1155.40	0.82	5.18	3.30	0.84	0.88	3.26	39.56	13873.46
1155.60	0.82	5.18	3.22	0.84	0.88	3.17	38.55	13912.01
1155.80	0.82	5.18	3.12	0.83	0.88	3.07	37.43	13949.44
1156.00	0.82	5.19	3.02	0.82	0.87	2.96	36.17	13985.61
1156.20	0.82	5.19	2.90	0.82	0.87	2.83	34.75	14020.36
1156.40	0.82	5.20	2.76	0.81	0.87	2.68	33.09	14053.45
1156.60	0.82	5.20	2.58	0.79	0.86	2.50	31.12	14084.57
1156.80	0.82	5.20	2.35	0.77	0.86	2.26	28.55	14113.12
1157.00	0.82	5.20	1.77	0.71	0.84	1.66	23.48	14136.60
1157.20	0.82	5.21	1.49	0.67	0.83	1.37	18.19	14154.79
1157.40	0.82	5.21	1.38	0.66	0.82	1.27	15.84	14170.64
1157.60	0.82	5.21	1.30	0.64	0.81	1.19	14.74	14185.37
1157.80	0.83	5.22	1.24	0.63	0.81	1.13	13.92	14199.30
1158.00	0.83	5.22	1.20	0.62	0.81	1.08	13.28	14212.57
1158.20	0.83	5.22	1.15	0.61	0.81	1.04	12.73	14225.30
1158.40	0.83	5.23	1.12	0.61	0.80	1.00	12.26	14237.57
1158.60	0.83	5.23	1.08	0.60	0.80	0.97	11.85	14249.42
1158.80	0.83	5.23	1.05	0.60	0.80	0.94	11.49	14260.91
1159.00	0.83	5.23	1.03	0.59	0.80	0.92	11.16	14272.07
1159.20	0.83	5.24	1.00	0.59	0.80	0.89	10.86	14282.94
1159.40	0.83	5.24	0.98	0.58	0.79	0.87	10.58	14293.52
1159.60	0.83	5.24	0.96	0.57	0.79	0.85	10.32	14303.84
1159.80	0.83	5.24	0.94	0.56	0.79	0.83	10.08	14313.92
1160.00	0.83	5.25	0.92	0.56	0.79	0.81	9.85	14323.77
1160.20	0.83	5.25	0.90	0.55	0.79	0.79	9.64	14333.41
1160.40	0.83	5.25	0.89	0.55	0.78	0.78	9.44	14342.85

1160.60	0.83	5.25	0.87	0.54	0.78	0.76	9.25	14352.10
1160.80	0.83	5.26	0.86	0.54	0.78	0.75	9.08	14361.18
1161.00	0.83	5.26	0.84	0.53	0.78	0.74	8.92	14370.10
1161.20	0.83	5.26	0.83	0.53	0.78	0.72	8.76	14378.86
1161.40	0.83	5.26	0.82	0.52	0.78	0.71	8.61	14387.47
1161.60	0.83	5.27	0.81	0.52	0.77	0.70	8.47	14395.95
1161.80	0.83	5.27	0.80	0.52	0.77	0.69	8.34	14404.29
1170.00	0.85	5.35	0.55	0.36	0.72	0.45	5.39	14672.16
1197.00	0.87	5.53	0.34	0.10	0.64	0.24	2.94	15186.05
1230.00	0.90	5.69	0.26	0.10	0.64	0.19	2.24	15604.82
1257.00	0.92	5.80	0.23	0.10	0.64	0.16	1.94	15885.35
1290.00	0.94	5.91	0.20	0.10	0.64	0.14	1.70	16184.32
1317.00	0.95	6.00	0.18	0.10	0.64	0.13	1.56	16404.12
1350.00	0.96	6.09	0.17	0.10	0.64	0.12	1.43	16650.58
1377.00	0.98	6.17	0.16	0.10	0.64	0.11	1.35	16837.97
1410.00	0.99	6.25	0.15	0.10	0.64	0.11	1.26	17053.02
1437.00	1.00	6.31	0.14	0.10	0.64	0.10	1.20	17219.42

APPENDIX C: BASIN SIZING ANALYSIS

APPENDIX C.1: STORAGE VOLUME CALCULATION BASIN A

SUBSURFACE BASIN "A" STORAGE VOLUME

TRACT MAP 83215
SUBSURFACE BASIN A STORAGE, LENGTH =100 FEET

BOTTOM ELEVATION	TOP ELEVATION	96" CMP AREA (ft^2)	GRAVEL AREA (ft^2)	96" CMP VOLUME (ft^3)[1, 2]	GRAVEL VOLUME (ft^3)	TOTAL VOLUME (ft^3)
493.5	494.5	0	11	0	440.00	440.00
494.5	495.5	3.626	7.374	362.60	294.96	1,097.56
495.5	496.5	6.2	4.805	620.00	192.20	1,909.76
496.5	497.5	7.39	3.62	739.00	144.80	2,793.56
497.5	498.5	7.916	3.072	791.60	122.88	3,708.04
498.5	499.5	7.916	3.072	791.60	122.88	4,622.52
499.5	500.5	7.39	3.62	739.00	144.80	5,506.32
500.5	501.5	6.2	4.805	620.00	192.20	6,318.52
501.5	502.5	3.626	7.374	362.60	294.96	6,976.08
502.5	503.5	0.00	11	0.00	440.00	7,416.08

1 - 96" Volume Represents the 96" CMP Area multiplied by the total linear feet of the system.

APPENDIX C.2: STORAGE VOLUME CALCULATION BASIN B

SUBSURFACE BASIN "B" STORAGE VOLUME

TRACT MAP 83215
SUBSURFACE BASIN B STORAGE, LENGTH =236 FEET

BOTTOM ELEVATION	TOP ELEVATION	96" CMP AREA (ft^2)	GRAVEL AREA (ft^2)	96" CMP VOLUME (ft^3)[1, 2]	GRAVEL VOLUME (ft^3)	TOTAL VOLUME (ft^3)
496	497	0	11	0	1038.40	1,038.40
497	498	3.626	7.374	855.74	696.11	2,590.24
498	499	6.2	4.805	1463.20	453.59	4,507.03
499	500	7.39	3.62	1744.04	341.73	6,592.80
500	501	7.916	3.072	1868.18	290.00	8,750.97
501	502	7.916	3.072	1868.18	290.00	10,909.15
502	503	7.39	3.62	1744.04	341.73	12,994.92
503	504	6.2	4.805	1463.20	453.59	14,911.71
504	505	3.626	7.374	855.74	696.11	16,463.55
505	506	0.00	11	0.00	1038.40	17,501.95

1 - 96" Volume Represents the 96" CMP Area multiplied by the total linear feet of the system.

APPENDIX C.3: STORAGE VOLUME CALCULATION BASIN C

SUBSURFACE BASIN "C" STORAGE VOLUME

TRACT MAP 83215
SUBSURFACE BASIN C STORAGE, LENGTH =77.4 FEET

BOTTOM ELEVATION	TOP ELEVATION	96" CMP AREA (ft^2)	GRAVEL AREA (ft^2)	96" CMP VOLUME (ft^3)[1, 2]	GRAVEL VOLUME (ft^3)	TOTAL VOLUME (ft^3)
495	496	0	11	0	341.00	341.00
496	497	3.626	8.374	281.02	259.59	881.61
497	498	6.2	5.8	480.50	179.80	1,541.91
498	499	7.39	4.61	572.73	142.91	2,257.54
499	500	7.916	4.084	613.49	126.60	2,997.64
500	501	7.916	4.084	613.49	126.60	3,737.73
501	502	7.39	4.61	572.73	142.91	4,453.37
502	503	6.2	5.8	480.50	179.80	5,113.67
503	504	3.626	8.374	281.02	259.59	5,654.28
504	505	0.00	11	0.00	341.00	5,995.28
			67.74			

1 - 96" Volume Represents the 96" CMP Area multiplied by the total linear feet of the system.

APPENDIX D: STORM DRAIN NORMAL DEPTH CALCULATIONS

Worksheet for 18-Inch Full Flow Capacity

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	5.75	ft³/s

Results

Discharge	5.75	ft³/s
Normal Depth	1.50	ft
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	0.93	ft
Percent Full	100.0	%
Critical Slope	0.00610	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.16	ft
Specific Energy	1.66	ft
Froude Number	0.00	
Maximum Discharge	6.19	ft³/s
Discharge Full	5.75	ft³/s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 18-Inch Full Flow Capacity

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	0.93	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00610	ft/ft

Worksheet for 24-Inch Full Flow Capacity

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft
Discharge	12.39	ft³/s

Results

Discharge	12.39	ft³/s
Normal Depth	2.00	ft
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.27	ft
Percent Full	100.0	%
Critical Slope	0.00567	ft/ft
Velocity	3.94	ft/s
Velocity Head	0.24	ft
Specific Energy	2.24	ft
Froude Number	0.00	
Maximum Discharge	13.33	ft³/s
Discharge Full	12.39	ft³/s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 24-Inch Full Flow Capacity

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.27	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00567	ft/ft

APPENDIX E: CATCH BASIN ANALYSES

Worksheet for GRATE INLET 1A

Project Description

Solve For	Spread

Input Data

Discharge		8.47	ft³/s
Left Side Slope		50.00	ft/ft (H:V)
Right Side Slope		50.00	ft/ft (H:V)
Bottom Width		4.00	ft
Grate Width		3.00	ft
Grate Length		4.00	ft
Local Depression		2.00	in
Local Depression Width		6.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	27.72	ft
Depth	0.24	ft
Wetted Perimeter	27.73	ft
Top Width	27.72	ft
Open Grate Area	3.60	ft²
Active Grate Weir Length	11.00	ft

Worksheet for COMBO INLET 1B.1

Project Description

Solve For	Efficiency

Input Data

Discharge		5.13	ft³/s
Slope		0.00500	ft/ft
Gutter Width		4.00	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		6.00	ft
Grate Width		4.00	ft
Grate Length		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		30.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency		67.43	%
Intercepted Flow		3.46	ft³/s
Bypass Flow		1.67	ft³/s
Spread		14.79	ft
Depth		0.30	ft
Flow Area		2.19	ft²
Gutter Depression		0.00	ft
Total Depression		0.33	ft
Velocity		2.34	ft/s
Splash Over Velocity		6.63	ft/s
Frontal Flow Factor		1.00	
Side Flow Factor		0.14	
Grate Flow Ratio		0.57	
Equivalent Cross Slope		0.05159	ft/ft
Active Grate Length		2.10	ft
Length Factor		0.05	
Total Interception Length		17.90	ft

Worksheet for COMBO INLET 1B.2

Project Description

Solve For	Efficiency

Input Data

Discharge		1.67	ft³/s
Slope		0.00500	ft/ft
Gutter Width		4.00	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		6.00	ft
Grate Width		4.00	ft
Grate Length		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		30.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	85.92	%
Intercepted Flow	1.43	ft³/s
Bypass Flow	0.24	ft³/s
Spread	9.71	ft
Depth	0.19	ft
Flow Area	0.94	ft²
Gutter Depression	0.00	ft
Total Depression	0.33	ft
Velocity	1.77	ft/s
Splash Over Velocity	6.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.21	
Grate Flow Ratio	0.76	
Equivalent Cross Slope	0.06207	ft/ft
Active Grate Length	2.10	ft
Length Factor	0.09	
Total Interception Length	10.00	ft

Worksheet for COMBO INLET 2B.1

Project Description

Solve For	Efficiency

Input Data

Discharge		3.37	ft³/s
Slope		0.00500	ft/ft
Gutter Width		4.00	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		6.00	ft
Grate Width		4.00	ft
Grate Length		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		30.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency		74.61	%
Intercepted Flow		2.51	ft³/s
Bypass Flow		0.86	ft³/s
Spread		12.64	ft
Depth		0.25	ft
Flow Area		1.60	ft²
Gutter Depression		0.00	ft
Total Depression		0.33	ft
Velocity		2.11	ft/s
Splash Over Velocity		6.63	ft/s
Frontal Flow Factor		1.00	
Side Flow Factor		0.16	
Grate Flow Ratio		0.64	
Equivalent Cross Slope		0.05542	ft/ft
Active Grate Length		2.10	ft
Length Factor		0.06	
Total Interception Length		14.37	ft

Worksheet for COMBO INLET 2B.1

Messages

Notes

0.86 cfs will Flow-By to Combo Inlet 3B.1

Worksheet for COMBO INLET 3B.1

Project Description

Solve For	Efficiency

Input Data

Discharge		3.04	ft³/s
Slope		0.00500	ft/ft
Gutter Width		4.00	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		6.00	ft
Grate Width		4.00	ft
Grate Length		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		30.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	76.35	%
Intercepted Flow	2.32	ft³/s
Bypass Flow	0.72	ft³/s
Spread	12.16	ft
Depth	0.24	ft
Flow Area	1.48	ft²
Gutter Depression	0.00	ft
Total Depression	0.33	ft
Velocity	2.06	ft/s
Splash Over Velocity	6.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.17	
Grate Flow Ratio	0.66	
Equivalent Cross Slope	0.05639	ft/ft
Active Grate Length	2.10	ft
Length Factor	0.07	
Total Interception Length	13.62	ft

Worksheet for COMBO INLET 3B.1

Messages

Notes

0.86 cfs will Flow-By to Combo Inlet 3B.1

Worksheet for COMBO INLET 3B.2

Project Description

Solve For	Efficiency

Input Data

Discharge		0.72	ft³/s
Slope		0.00500	ft/ft
Gutter Width		4.00	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		6.00	ft
Grate Width		4.00	ft
Grate Length		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		30.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	96.05	%
Intercepted Flow	0.69	ft³/s
Bypass Flow	0.03	ft³/s
Spread	7.08	ft
Depth	0.14	ft
Flow Area	0.50	ft²
Gutter Depression	0.00	ft
Total Depression	0.33	ft
Velocity	1.43	ft/s
Splash Over Velocity	6.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.28	
Grate Flow Ratio	0.89	
Equivalent Cross Slope	0.06951	ft/ft
Active Grate Length	2.10	ft
Length Factor	0.14	
Total Interception Length	6.56	ft

Worksheet for COMBO INLET 3B.2

Messages

Notes

0.86 cfs will Flow-By to Combo Inlet 3B.1

Worksheet for CB-1C-1

Project Description

Solve For	Spread

Input Data

Discharge		1.88	ft^3/s
Gutter Width		2.00	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		4.00	ft
Opening Height		0.83	ft
Curb Throat Type	Inclined		
Local Depression		4.00	in
Local Depression Width		4.00	ft
Throat Incline Angle		33.70	degrees

Results

Spread	3.81	ft
Depth	0.30	ft
Gutter Depression	0.13	ft
Total Depression	0.46	ft

Worksheet for CB-1C-2

Project Description

Solve For	Spread

Input Data

Discharge		1.88	ft^3/s
Gutter Width		2.00	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		3.50	ft
Opening Height		0.83	ft
Curb Throat Type	Inclined		
Local Depression		4.00	in
Local Depression Width		4.00	ft
Throat Incline Angle		33.70	degrees

Results

Spread	3.84	ft
Depth	0.31	ft
Gutter Depression	0.13	ft
Total Depression	0.46	ft

APPENDIX F: LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS "ALLOWABLE FLOW RATE"

Office Use Only
☐ Sent Initials: _____
☐ Fax ☐ Email ☐ Other: _____
Date: _____ Time: _____

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION – HYDRAULIC ANALYSIS UNIT

INFORMATION REQUEST SUMMARY

INFORMATION REQUESTED BY

*Requester's Name: Jennifer Lange Colicchio
Company: Land Development Consultants
*Phone Number: 714-557-7700 Fax Number: _____
*Email: jlange@ldc-ce.com

Method of Contact: ☐ Walk-in ☐ Phone ☐ Fax ☒ Email ☐ Prelim. Mtg. Date: 10/24/18

Intended Use: Need allowable Q for proposed development

Proposed Project Type: Mixed-Use Acreage Involved: 5 AC

*Will information be used in any litigation? ☐ YES ☒ NO
Case Info. Name: _____ No: _____ Location: _____

INFORMATION REQUESTED (Attach Assessor Map)

LACFCD Facility: Name: Badillo Avenue Line A
Unit: No.275-519-D1.11 Line: A Station: 149+00.00
City: Covina
*Street/Cross-street: NEC of Cypress and Azusa
*Thomas Guide: Page: 598 Grid: J4 ☒ Site Map/Plans Submitted
Info. Requested: Allowable Q, Hydraulic Calculation, As Built Drawing.

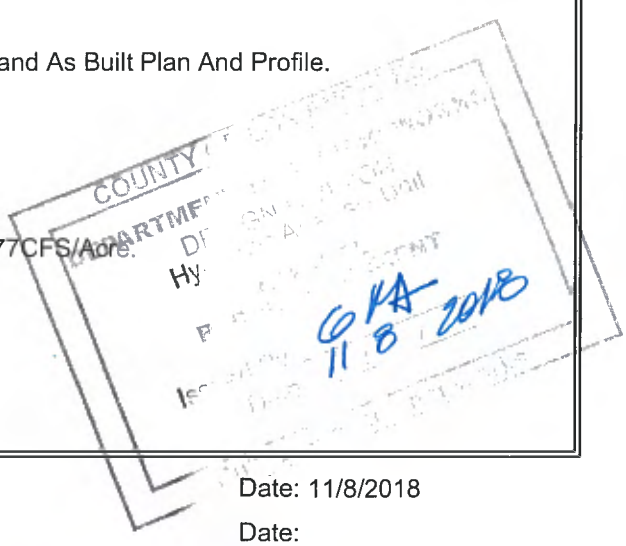
***Required Information. See Page 2 of 2 for Instructions.**

BELOW SECTION TO BE COMPLETED BY THE HYDRAULIC ANALYSIS UNIT

INFORMATION PROVIDED:
Hydrology Data, Drainage Map, Hydraulic Calculation Sheet, and As Built Plan And Profile.

REFERENCES SEARCHED:
Project No. 519 Line "A" Files Drawing No. 275-519-D1.11

COMMENTS, ETC:
Sub Area 25 Allowable Q=(19.00/17.50)x(407.70/576.00)=0.77CFS/Acre.



INFORMATION PROVIDED BY: George K Aintablian Date: 11/8/2018
INFORMATION REVIEWED BY: Date:

Print Save a Copy

* Drainage Sub Area 25
Allowable Q = 19/17.5 × 407.70/576 = 0.77 cfs/acre

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT — Sht. 2 of

Hydrology Calculation Sheet

PROJECT 423 & 519
FREQUENCY 10-YR
ISOHYETAL ZONE L

CALCULATED BY R.E.P & G.J.P
CHECKED BY
DATE 10/30/59

Rec. No. 519 — Rec. No. 423

DRAINAGE AREA	Soil & Development	A Acres	I in/hr.	C	ΔQ CFS	ΣQ CFS	SLOPE	SECTION	v FPS	L FT.	T MIN.	ΣT MIN.	REMARKS
												23.4	Cont'd from p.1
Part (18)	Hf sf	9.5	1.79	.758	12.9	132.5	.004	67' ○	8.3	250	.5	23.9	In Citrus @ Cypress Jct (423)
						145.4	Qa	Pipe B (519)					
264.2+	1.58 145.4	= 393.2	@ 31.9										
	1.78											31.9	
(19) (26), Part (27)	Hf sf	53.9	1.54	.733	60.8	393.2	0142	66' ○	18	1500	1.4	33.3	In Cypress @ North Fourth
(20) (21)	✓ ✓	26.8	1.53	.732	30	454.0	✓	69' ○	19.1	450	.4	33.7	✓ @ Fircroft
						484	✓	72' ○	19	550	.5	34.2	✓ @ Hollenbeck
													End (423) Start (519)
													Pick up Area (22)
						484							
22	Hf – S.F.	13.4	1.52	.73	15	499	.0085	78" RCP	16.4	350	0.4	34.2	CYPRESS @ HOLLENBECK
23		10.3	1.51	.73	11	510	✓	81" ✓	15.3	1580	1.7	34.6	✓ @ LARKIN
24		44.3	1.48	.72	47	557	.0157	75" ✓	20	800	0.7	36.3	✓ @ CONWISE
* 25		17.5	1.47	.72	19	576	.0116	✓	21	1930	1.5	37.1	✓ @ AZUSA
28-31		71.3	1.45	.72	74	650	.005	96" ✓	13.8	850	1.0	38.6	✓ @ SAN DIMAS WASH
32		13.8	1.44	.72	14	664	.005	✓	14.2	170	0.2	39.6	IN SAN DIMAS WASH @ PICKUP PT.
33-36		68.7	1.43	.71	70	734	.0044	105" ✓	13	850	1.1	39.8	✓ @ ✓
37-38		20.2	1.41	.71	20	754	.008	93" ✓	17	1020	1	40.9	✓ @ P.E. R.R.
40, ½(41)		55.1	1.40	.71	55	809	.019	90" ✓	19.5	460	0.4	41.9	✓ @ SCHOOL DRIVE
39, ½(41)		52	1.39	.71	51	860	.005	108" ✓	14.4	1250	1.5	42.3	✓ @ SAN DIMAS WASH
42-86	Hs - S.F.	56.9	1.37	.66	513	1373	.0167	102" ✓	23.8	340	0.2	43.8	✓ @ BADILLO
87-91	Hf - S.F.	113.2	1.36	.70	105	1481	.001	RCP	10.7	650	1.0	44.0	BADILLO @ VINCENT
92-93		16.7	1.35	.70	16	1497	.008	RCP	18.1	300	0.3	45.0	✓ @ MIRANDA
												45.3	✓ @ HARTLEY

DA-2

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

Hydraulic Calculation Sheet

Sht 2 of ___

PROJECT No. 519-A

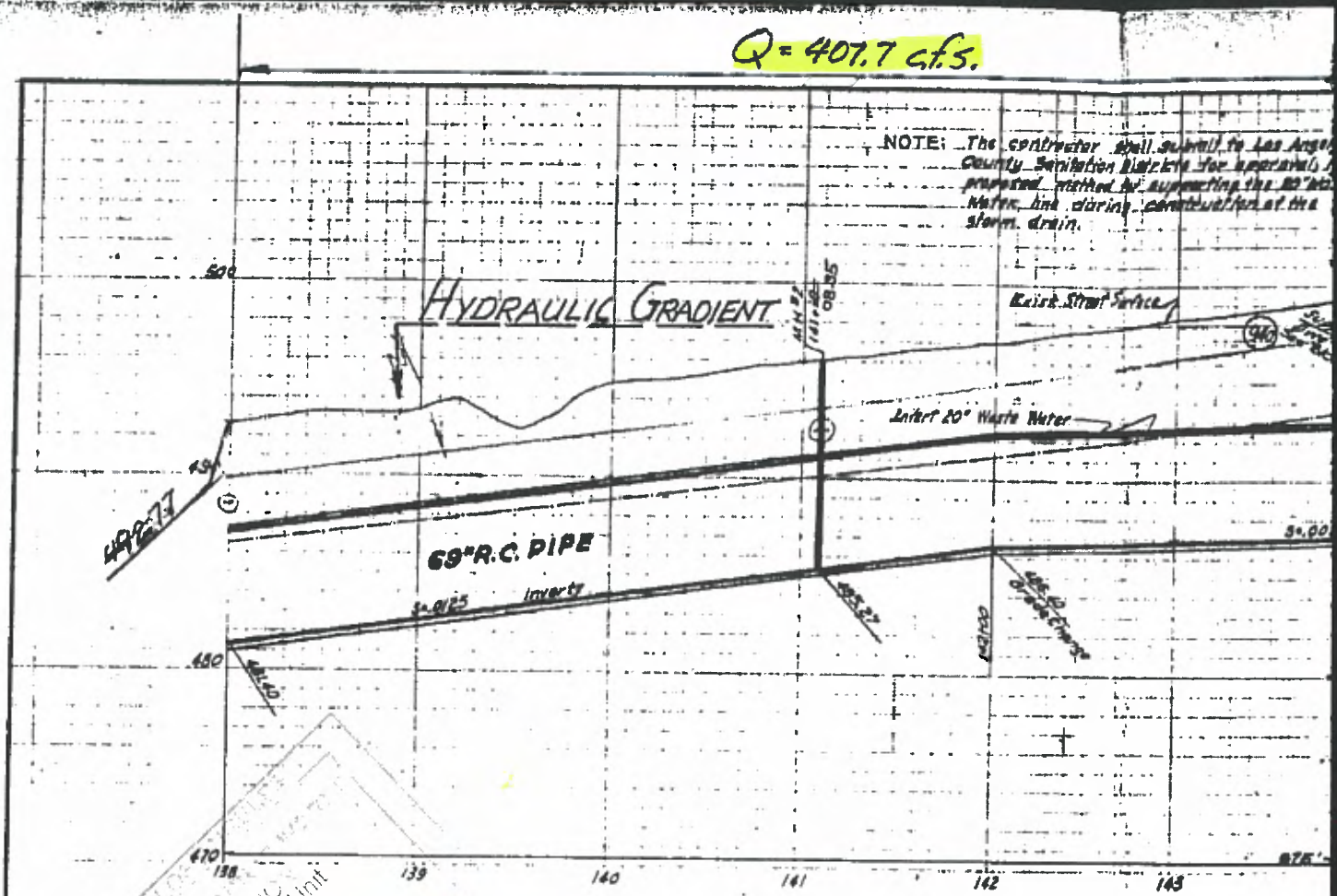
CALCULATED BY ___

DATE ___

STA.	ELEV. INV.	D	ELEV. W.S.	SECTION	A	K	Q	V	$\frac{v^2}{2g}$	E.G.	S_f	Av. S_f	L	h_f	h_b	h_j	h_t	E.G.
116+43.5		459.66	[illegible]	81"⊖	35.79	5796	514.2	14.38	3.20	[illegible]	.00787							462.86
"		459.71	[illegible]	72"⊖	28.27	4236	459	16.32	4.10	[illegible]	.001178	—	—	1.92	—	.95		463.81
118+12		461.69	[illegible]	"	"	"	"	[illegible]	[illegible]	462.83	"	.001178	168.5	.20				465.79
"		462.03	[illegible]	"	"	"	450	16.54	4.22	[illegible].45	.00113	—	—	—	⊘	.12 (.17)		465.96
121+46		466.01	[illegible]	"	"	"	"	"	"	[illegible]	"	[illegible]	334	.38		MH .21		469.94
125+00		470.01	[illegible]	"	"	"	"	"	"	[illegible].21	"	"	354	4.00				473.94
126+70		472.58	[illegible]	"	"	"	"	"	"	[illegible].63	"	"	170	1.92	.6[illegible]			476.51
"		472.52	[illegible]	66"⊖	23.76	3358	407.7	17.18	4.58	[illegible].24	.01474	—	—	—	—	.59		477.10
130+00		477.39	[illegible]	"	"	"	"	"	"	[illegible]	"	.01474	330	4.87				481.97
131+30		477.54	[illegible]	"	"	"	"	"	"	[illegible].94	"	"	130	1.42	0		MH .23	484.12
132+36		481.10	[illegible]	"	"	"	"	"	"	[illegible].50	"	"	106	.56				485.68
136+30		487.14	[illegible]	"	"	"	"	"	"	[illegible]	"	"	394	5.81			MH .23	491.72
"		487.95	[illegible]	69"⊖	25.97	3780	"	15.[illegible]	3.59	[illegible]	.01160	—	-	—	-	—	.07	491.79
138+00		489.92	[illegible]	"	"	"	"	"	"	[illegible]	.0161 "	.01160	170	1.92				493.76
141+08		493.68	[illegible]	"	"	"	"	"	"	[illegible]	.0157 "	"	308	3.57			MH .24	497.53
144+44		498.14	[illegible]	"	"	"	"	"	"	[illegible]	"	"	336	3.90	.56			501.48
144+80		499.12	[illegible]	"	"	"	"	"	"	[illegible]	"	"	36	.42	.56			502.46
145+67		500.13	[illegible]	"	"	"	"	"	"	[illegible]	"	"	87	1.01				503.97
"		500.59	[illegible]	"	"	"	345.8	15.25	3.61	[illegible]	.001093	—	—	—	—	.23		504.2[illegible]
146+00	501.[illegible]	500.[illegible]	[illegible]	"	"	"	"	"	"	[illegible]	"	.001093	33	.04	[illegible]		MH .16	514.7[illegible]
147+63	50[illegible]	501.51	[illegible]	"	"	"	"	"	"	[illegible]	"	"	163	.18	.52			[illegible]
148+04	50[illegible]	502.97	[illegible]	"	"	"	"	"	"	[illegible]	"	"	41	.04	.52			[illegible]
150+00	50[illegible]	502.[illegible]	50[illegible].13	"	"	"	"	"	"	[illegible]	"	"	196	.21				51[illegible].17
			502.26	"	~~Beginning~~			—	"	505.[illegible]	"	"	—					
~~150+82~~			502.52	"	"	"	"	"	"	506.16	"		~~82~~	.04			5[illegible]	

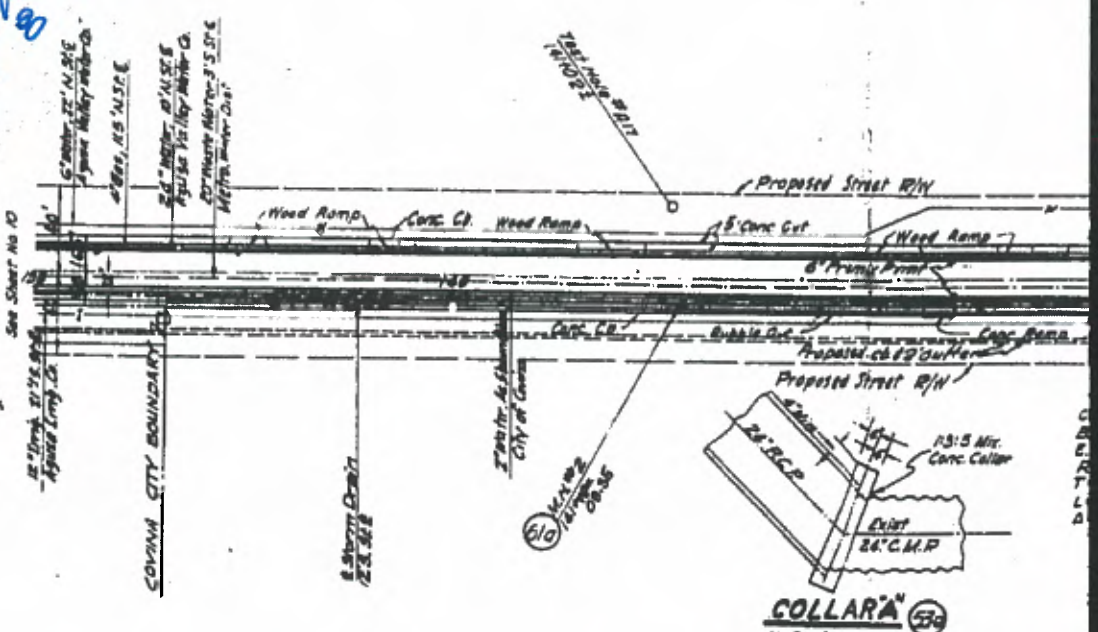
DB-3

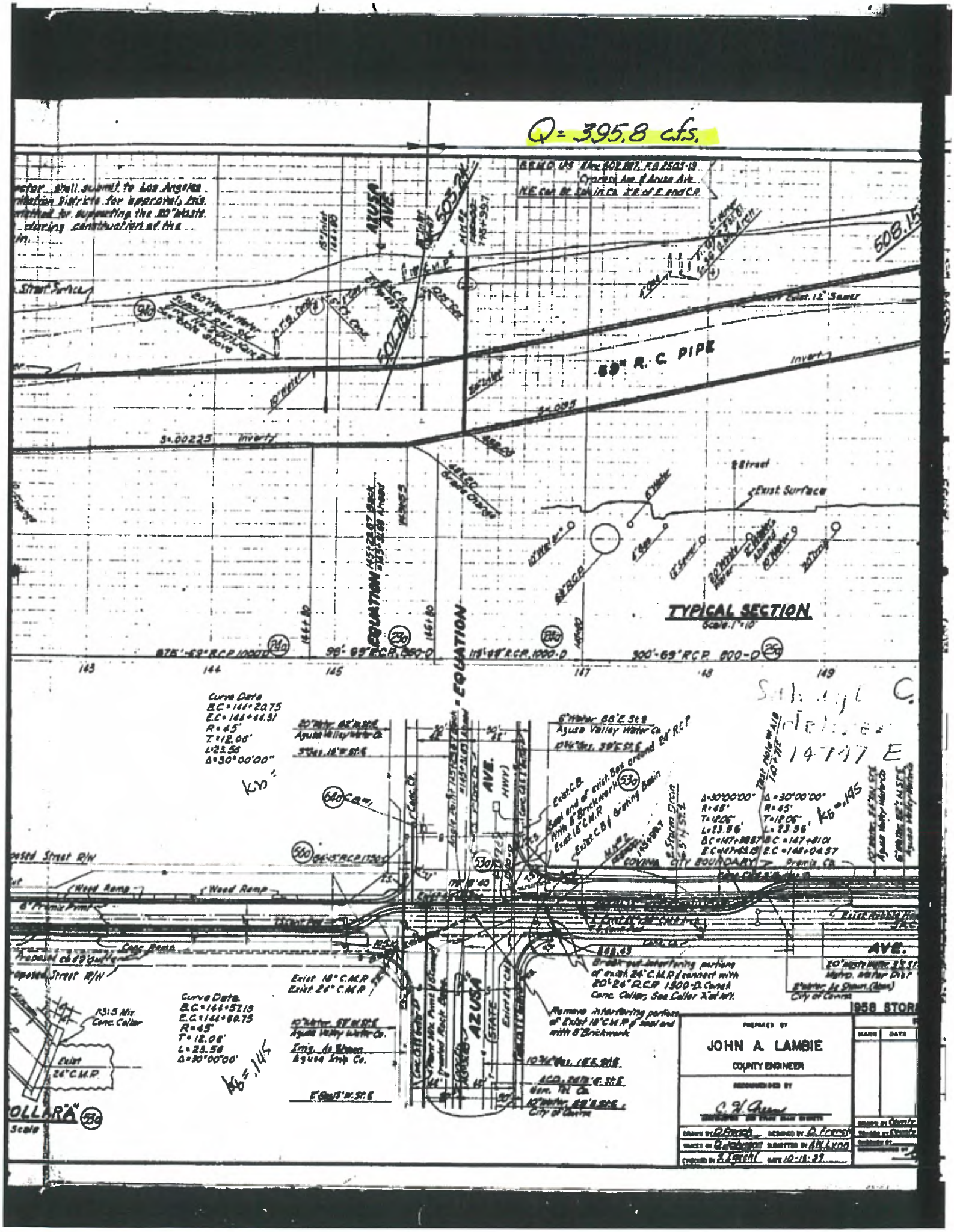
Q = 407.7 cf.s.

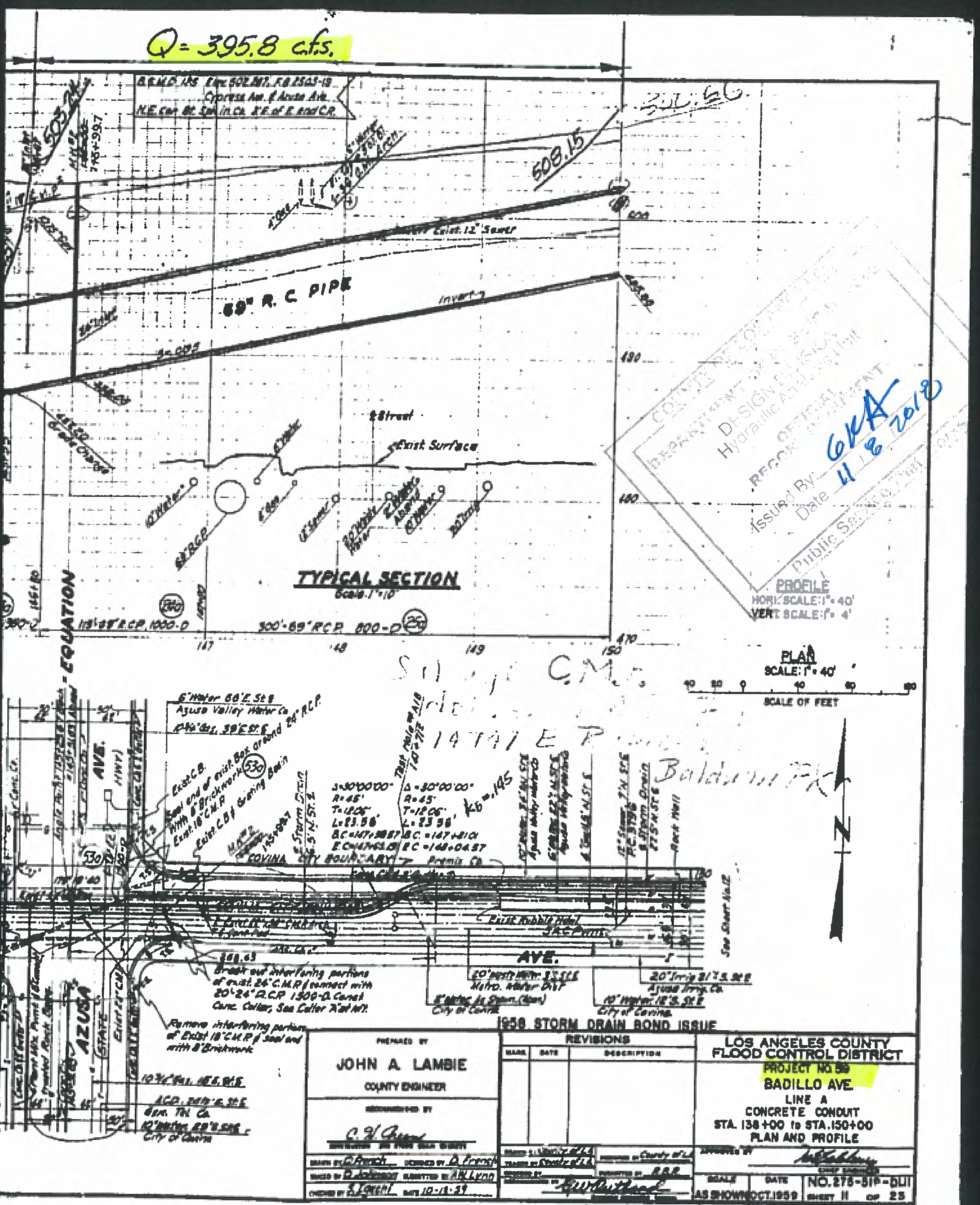


COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
Hydraulic Analysis Unit
Issued By
Date 4/8/16

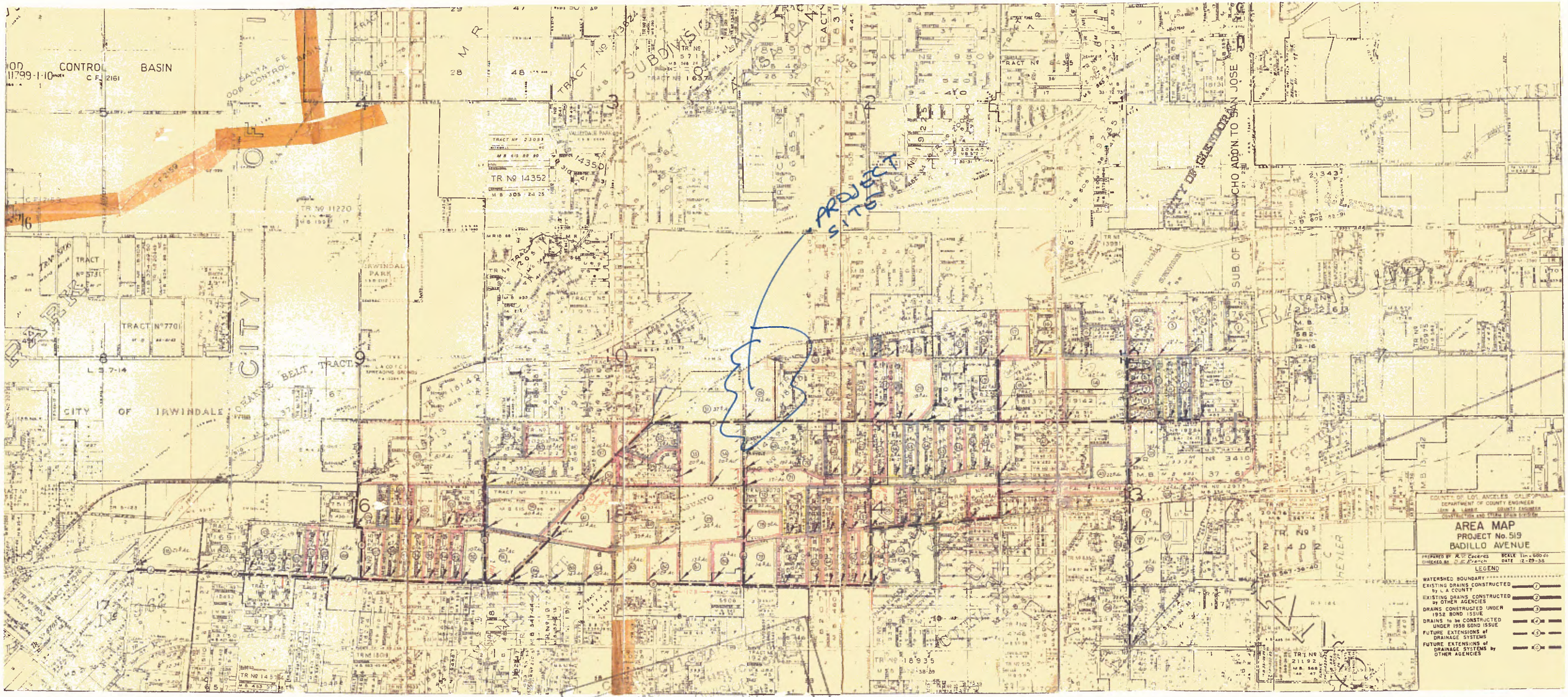
6KA 2016

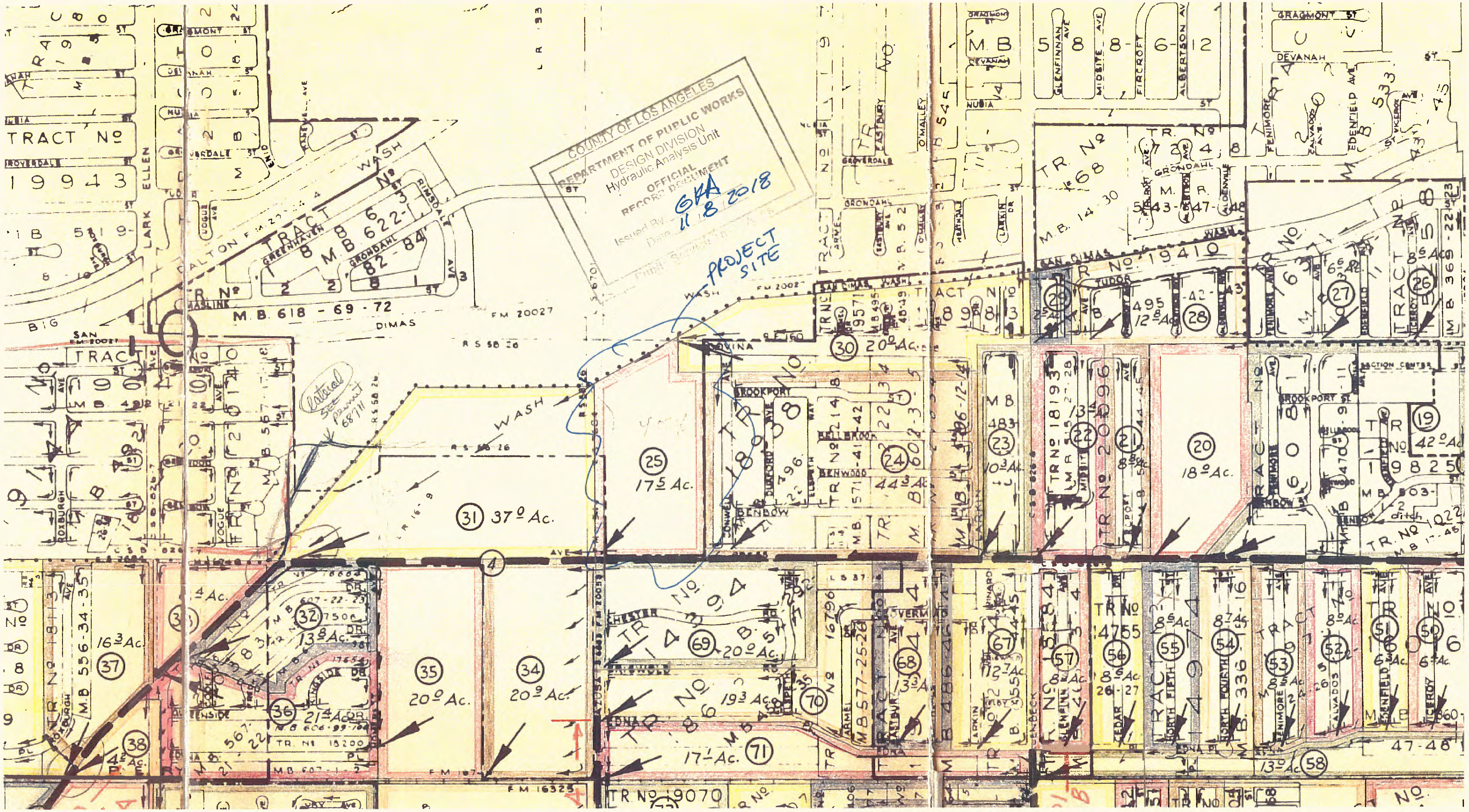



Q = 395.8 cfs.
AZUSA AVE.
69" R.C. PIPE
TYPICAL SECTION
EQUATION
AVE.
JOHN A. LAMBIE
COUNTY ENGINEER



Q= 395.8 c.f.s.
508.15
69" R. C. PIPE
Exist. 12" Sewer
Invert
℄ Street
Exist. Surface
TYPICAL SECTION
Scale: 1"=10'
300'-69" RCP 800-D
PROFILE
HORIZ. SCALE: 1"= 40'
VERT. SCALE: 1"= 4'
PLAN
SCALE: 1"= 40'
SCALE OF FEET
EQUATION
AZUSA AVE.
COVINA CITY BOUNDARY
AVE.
See Sheet No. 12
Issued By: GKA
Date: 11.8.2018
1958 STORM DRAIN BOND ISSUE
REVISIONS
PREPARED BY
JOHN A. LAMBIE
COUNTY ENGINEER
LOS ANGELES COUNTY
FLOOD CONTROL DISTRICT
PROJECT NO. 59
BADILLO AVE.
LINE A
CONCRETE CONDUIT
STA. 138+00 to STA. 150+00
PLAN AND PROFILE
AS SHOWN
OCT. 1959
SHEET 11 OF 23





COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
Hydraulic Analysis Unit
OFFICIAL RECORD DOCUMENT
Issued By GKA
Date 11 8 2018
PROJECT SITE
TRACT No 19943
BIG DALTON WASH
SAN DIMAS WASH
M.B. 618 - 69 - 72
FM 20027
COVINA
BROOKPORT
BELLBROOK
BENWOOD
BENBOW
GRONDAHL
GROVERDALE
NUBIA
DEVANAH
GRAGMONT ST
TUDOR
TR No 19410
CHESTER
FRISWOLD
EDNA PL
CEDAR
NORTH FIFTH
NORTH FOURTH
FM 16325
TR No 19070
31 37.0 Ac.
25 17.5 Ac.
30 20.0 Ac.
24 44.3 Ac.
23 10.3 Ac.
20 18.0 Ac.
19 42.0 Ac.
37 16.3 Ac.
35 20.0 Ac.
34 20.9 Ac.
69 20.0 Ac.
71 17.1 Ac.
58 13.0 Ac.

APPENDIX G: INFILTRATION TEST BY GEO CONCEPTS

EXHIBITS

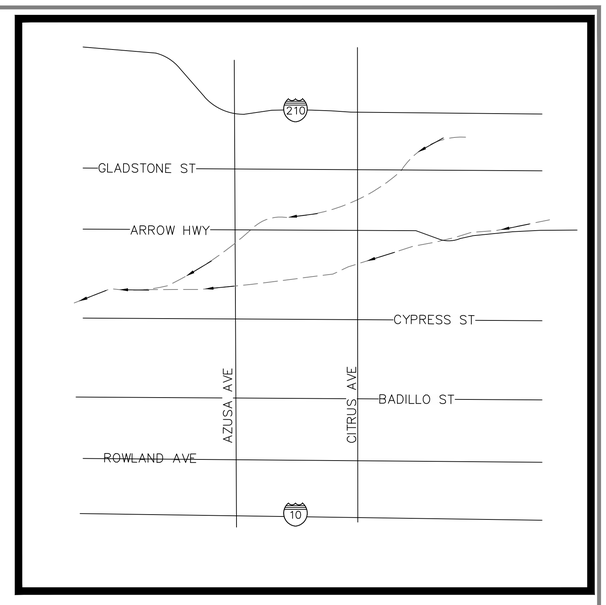
EXHIBIT A: CATCH BASIN & INLET HYDROLOGY MAP

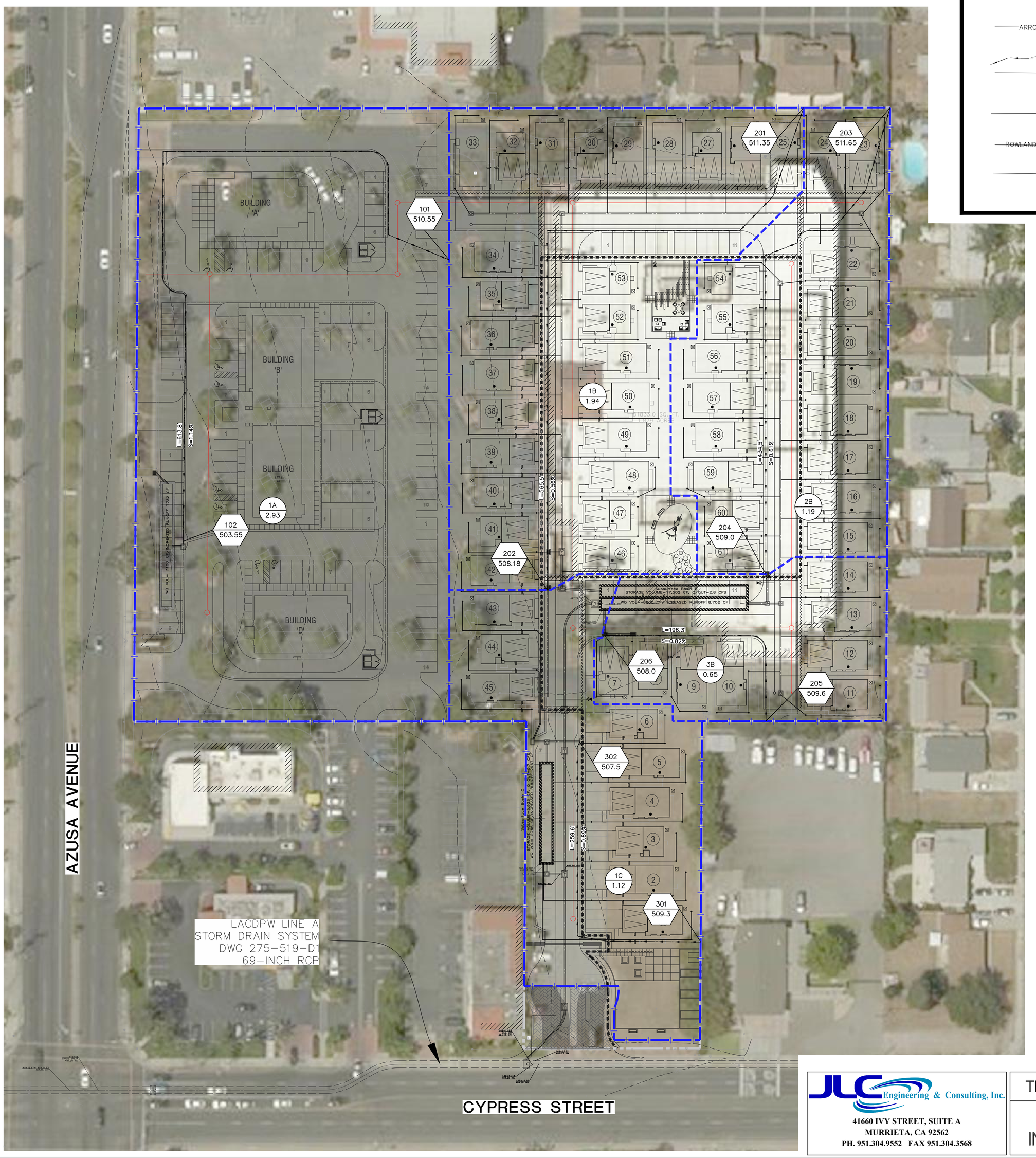
SHEET 1 OF 1

TENTATIVE TRACT MAP NO. 83215

IN THE CITY OF COVINA, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

POST-PROJECT INLET HYDROLOGY MAP





25 YEAR POST PROJECT FLOW RATES

SUBAREA	PEAK FLOW (ft^3/s)
1A	8.47
1B	5.13
2B	3.37
3B	2.18
1C	3.76

LEGEND:

- X.X / X.X — NODE/CONCENTRATION POINT / FLOWLINE ELEVATION
- XXX / X.X — SUB AREA / ACRES
- FLOW PATH
- WATERSHED BOUNDARY
- WATERSHED SUB-AREAS

HYDROLOGY DATA

SOIL TYPE: 006

50 YR RAINFALL: 7.2 INCHES

N

GRAPHIC SCALE
30' 0 15' 30' 60'
1" = 30'

EXHIBIT "A"

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

TENTATIVE TRACT MAP 83215

POST-PROJECT INLET HYDROLOGY MAP

Drawing Name: G:\205.17.18\Engineering\Hydrology_Plan\Exhibits\Exhibit A Inlet Hydrology Map.dwg
Last Opened: Nov 25, 2019 - 11:57am by jsc

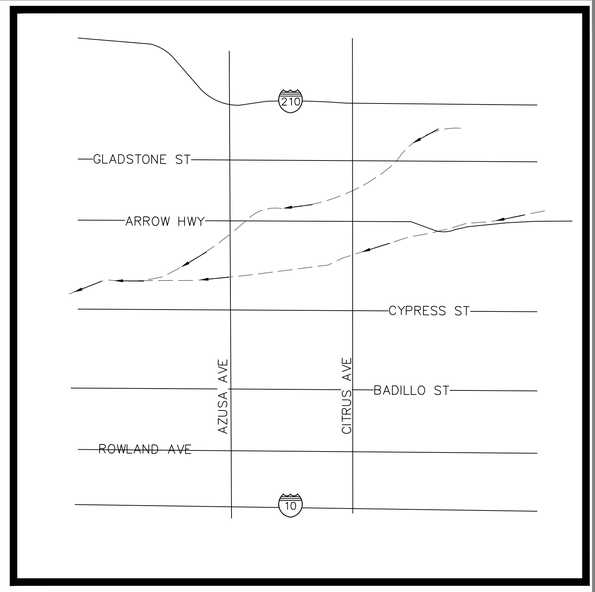
EXHIBIT B: DRAINAGE FACILITIES MAP

SHEET 1 OF 1

TENTATIVE TRACT MAP NO. 83215

IN THE CITY OF COVINA, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

DRAINAGE FACILITIES MAP



BUILDING 'A'

BUILDING 'B'

BUILDING 'D'

DRAINAGE AREA A
2.93 ACRES

DRAINAGE AREA B
3.78 ACRES

DRAINAGE AREA C
1.12 ACRES

SUBSURFACE BASIN A
V_{REQ}=7,002 ft^3
$V_{PROVIDED}$=7,416 ft^3

CATCH BASIN 1A
Q_{25}= 8.47 ft^3/s
W=3'x4' INLET

LATERAL 1A
Q_{25}= 8.47 ft^3/s
D=24"

GRATED INLET 1B.1
Q_{25}=5.13 ft^3/s
3'X4'

GRATED INLET 1B.2
Q_{25}=1.67 ft^3/s
3'X4'

LATERAL B1
Q_{25}=5.13 ft^3/s
D=18"

LATERAL B3
Q_{25}=2.18 ft^3/s
D=18"

GRATED INLET 2B
Q_{25}=3.37 ft^3/s
3'X4'

LATERAL B2
Q_{25}=3.37 ft^3/s
D=18"

SUBSURFACE BASIN B
V_{REQ}=17,294.7 ft^3
$V_{PROVIDED}$=17,502 ft^3

GRATED INLET 3B.1
Q_{25}=3.04 ft^3/s
3'X4'

GRATED INLET 3B.2
Q_{25}=0.728 ft^3/s
3'X4'

LATERAL B
Q_{25}=2.8 ft^3/s
D=18"

LATERAL A
Q_{25}=2.2 ft^3/s
D=18"

CATCH BASIN 2C
Q_{25}=1.88 ft^3/s
W=4'

CATCH BASIN 1C
Q_{25}=1.88 ft^3/s
W=4'

LATERAL 1C
Q_{25}=3.76 ft^3/s
D=18"

SUBSURFACE BASIN C
V_{REQ}=5,548.2 ft^3
$V_{PROVIDED}$=5,933 ft^3

LATERAL C
Q_{25}=0.7 ft^3/s
D=18"

LATERAL A
Q_{25}=3.5 ft^3/s
D=18"

LACDPW LINE A
STORM DRAIN SYSTEM
DWG 275-519-D1
69-INCH RCP

AZUSA AVENUE

CYPRESS STREET

25 YEAR INLET FLOW RATES

SUBAREA	PEAK FLOW (ft^3/s)	BY-PASS
1A	8.47	0.00
1B.1	5.13	1.67
1B.2	1.67	0.24
2B	3.37	0.86
3B.1	3.04	0.720
3B.2	0.72	0.030
1C	1.88	0.00
2C	1.88	0.00

LEGEND:

WATERSHED BOUNDARY

HYDROLOGY DATA

SOIL TYPE: 006

50 YR RAINFALL: 7.2 INCHES

N

GRAPHIC SCALE
30' 0 15' 30' 60'
1" = 30'

EXHIBIT "B"

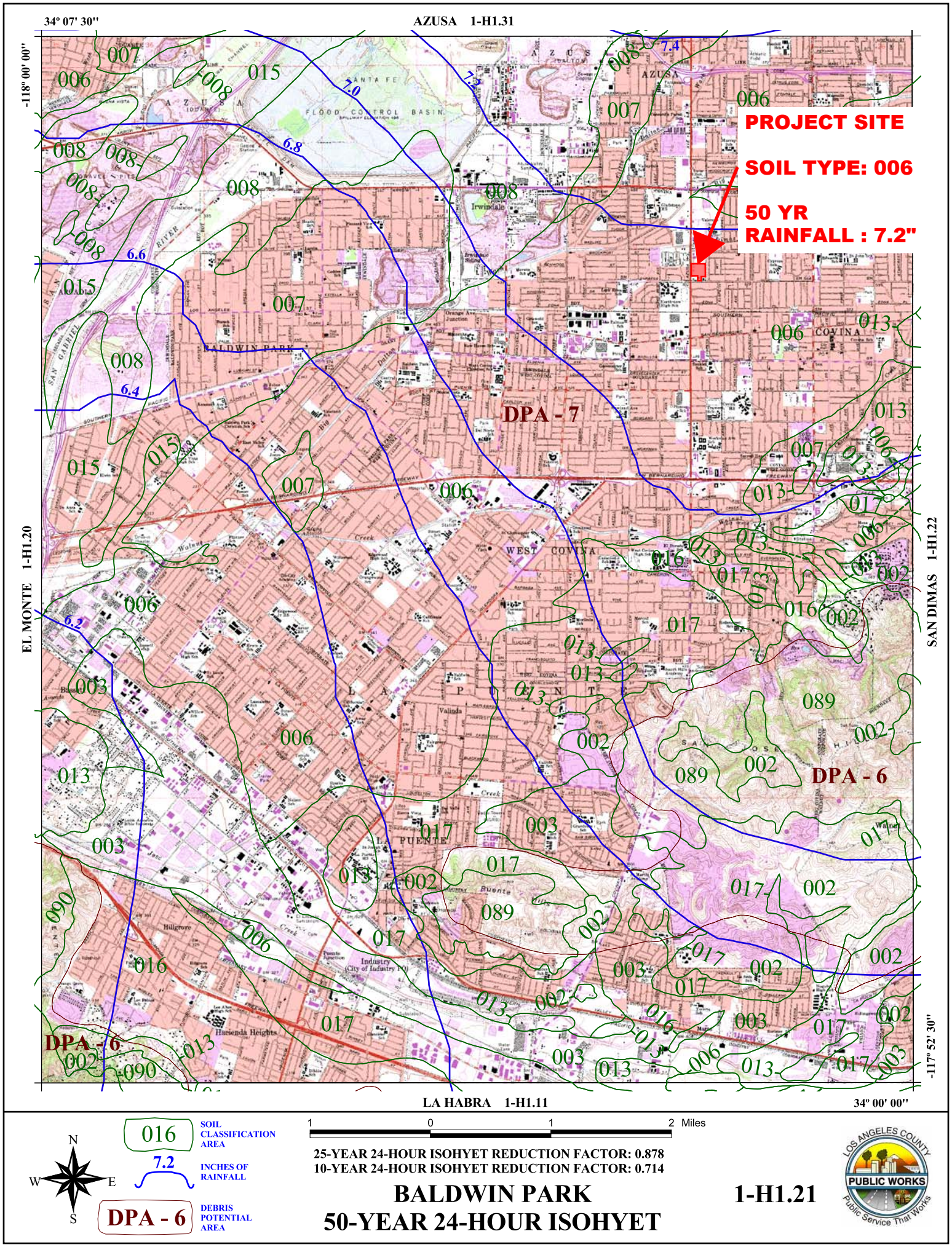
TENTATIVE PARCEL MAP 83215

DRAINAGE FACILITIES MAP

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: G:\205.17.18\Engineering\Hydrology_Plan\Exhibits\Exhibit B Drainage Facilities Map.dwg
Last Opened: Nov 25, 2019 - 11:50am by jac

EXHIBIT C: RAINFALL & SOIL DATA MAP


34° 07' 30"
AZUSA 1-H1.31
-118° 00' 00"
PROJECT SITE
SOIL TYPE: 006
50 YR
RAINFALL : 7.2"
DPA - 7
DPA - 6
DPA - 6
EL MONTE 1-H1.20
SAN DIMAS 1-H1.22
LA HABRA 1-H1.11
34° 00' 00"
-117° 52' 30"
016 SOIL CLASSIFICATION AREA
7.2 INCHES OF RAINFALL
DPA - 6 DEBRIS POTENTIAL AREA
1 0 1 2 Miles
25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714
BALDWIN PARK
50-YEAR 24-HOUR ISOHYET
1-H1.21
LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

Appendix E:
Hydrology Report and Low Impact Development Plan

Part 2: Low Impact Development Plan

Low Impact Development Plan
(LID Plan)

Project Name:

Tentative Tract Map No. 82315

1000 N. Azusa Ave. & 845 W. Cypress St.

Covina, CA 91722

Prepared for:

PKL Investments, LLC

2863 Maricopa Street

Torrance, CA 90503

(714) 738-0828

Prepared by:

Land Development Consultants

1520 Brookhollow Drive, Suite 33

Santa Ana, CA 92705

(714) 557-7700

PE Stamp & Sign Here

Date Prepared – 11/22/19

Project Owner's Certification

I certify under penalty of law that this document and all attachments were prepared under my jurisdiction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathered the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner's Name:			
Owner's Title:			
Company:	PKL Investments, LLC		
Address:	2863 Torrance, CA 90503		
Email:			
Telephone No:	(714) 738-0828		
Signature:		Date:	

Preparer (Engineer) Certification

Engineer's Name:	Hersel Moussa-Zahab		
Engineer's Title:	Principal		
Company:	Land Development Consultants		
Address:	1520 Brookhollow Drive, Suite 33		
Email:	hzahab@ldc-ce.com		
Telephone No:	(714) 557-7700		
I hereby certify that this Low Impact Development Plan is in compliance with, and meets the requirements set forth in, Order No. R4-2012-0175, of the Los Angeles Regional Water Quality Control Board.			
Engineer's Signature		Date	
Place Stamp Here			

Table of Contents

Attachments

1. PROJECT DESCRIPTION

1.1. PROJECT CATEGORY

Category	YES	NO
1. Development [a] of a new project equal to 1 acre or greater of disturbed area and adding more than 10,000 square feet of impervious area [b]	☒	☐
2. Development [a] of a new industrial park with 10,000 square feet or more of surface area [c]	☐	☐
3. Development [a] of a new commercial mall with 10,000 square feet or more surface area [c]	☐	☐
4. Development [a] of a new retail gasoline outlet with 5,000 square feet or more of surface area [c]	☐	☐
5. Development [a] of a new restaurant (SIC 5812) with 5,000 square feet or more of surface area [c]	☐	☐
6. Development [a] of a new parking lot with either 5,000 ft^2 or more of impervious area [b] or with 25 or more parking spaces	☐	☐
7. Development [a] of a new automotive service facility (SIC 5013, 5014, 5511, 5541, 7532-7534 and 7536-7539) with 5,000 square feet or more of surface area [c]	☐	☐
8. Projects located in or directly adjacent to, or discharging directly to a Significant Ecological Area (SEA),[d] where the development will: a. Discharge stormwater runoff that is likely to impact a sensitive biological species or habitat; and b. Create 2,500 square feet or more of impervious area [b]	☐	☐
9. Redevelopment [e] of 5,000 square feet or more in one of the categories listed above **If yes, list redevelopment category here:**	☐	☐
10. Redevelopment [e] of 10,000 square feet or more to a Single Family Home, without a change in landuse.	☐	☐

a Development includes any construction or demolition activity, clearing, grading, grubbing, or excavation or any other activity that results in land disturbance.

b Surfaces that do not allow stormwater runoff to percolate into the ground. Typical impervious surfaces include: concrete, asphalt, roofing materials, etc.

c The surface area is the total footprint of an area. Not to include the cumulative area above or below the ground surface.

d An area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and would be disturbed or degraded by human activities and developments. Also, an area designated by the City as approved by the Regional Water Quality Control Board.

e Land-disturbing activities that result in the creation, addition, or replacement of a certain amount of impervious surface area on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain the original line and grade, hydraulic capacity, or original purpose of facility, nor does it include modifications to existing single family structures, or emergency construction activities required to immediately protect public health and safety.

1.2. PROJECT DESCRIPTION

Total Project Area (ft^2): 344,786

Total Project Area (Ac): 7.91

EXISTING CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	51,160	14.8
Impervious Area:	293,626	85.2

PROPOSED CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	110,781	32.1
Impervious Area:	234,005	67.9

SITE CHARACTERISTICS

DRAINAGE PATTERNS/CONNECTIONS	Existing: Existing project site is currently a supermarket center that is no longer operational. The project is surrounded by residential homes to the north and west and commercial property to the south. Storm water sheet flows westerly to Azusa Avenue.
	Proposed: The project site will collect the onsite flows via curb and gutters, catch basins and subsurface storm drain. Pretreatment to be provided for identified pollutants of concern associated with proposed land use type via Stormexx Clean Catch Basin Inserts at (8) identified inlets upstream of basins. The onsite flows will be conveyed to three proposed subsurface basins within the project site. The subsurface systems have been designed to allow the DCV to infiltrate into the in-situ soils via perforated aluminized steel type 2 CMPs. Geotechnical reports indicate that the project has infiltration rates that range from 1.3 inches/hour to 3.3 inches/hour. The lower halfs of the basin systems will be used solely to impound the WQ volume and promote groundwater infiltration.
NARRATIVE PROJECT DESCRIPTION:	Tract 82315 is a proposed commercial and single family residential development that proposes to construct 61 residential homes, 3 commercial lots/buildings, subsurface basins, subsurface storm drain and internal streets.

OFFSITE RUNON	Offsite runon not anticipated.
UTILITY AND INFRASTRUCTURE INFORMATION	There are no known existing onsite utility and/or infrastructure that will conflict with proposed stormwater facilities. The proposed sewer, water and dry utility improvements designed to not conflict with proposed subsurface infiltration system.
SIGNIFICANT ECOLOGICAL AREAS (SEAS)	There are no known SEAs.
RECEIVING WATERS	Receiving waterbodies that follow are Walnut Creek Wash, San Gabriel River Reach 3, San Gabriel River Reach 2, San Gabriel River Reach 1 and the San Gabriel River Estuary. The above mentioned receiving waterbodies are listed for water quality impairment on the most recent 303(d)-list for: * Benthic-Macroinvertebrate Bioassessments * Indicator Bacteria * pH * Coliform Bacteria * Cyanide * Lead * Copper * Dioxin * Nickel * Oxygen, Dissolved

Hydromodification Analysis

DOES THE PROPOSED PROJECT FALL INTO ONE OF THE FOLLOWING CATEGORIES? CHECK YES/NO.	YES	NO
1. *Project is a redevelopment that decreases the effective impervious area compared to the pre-project conditions.*	☒	☐
Describe: Project will decrease impervious surface area from 85.2% to 67.9%.		
2. *Project is a redevelopment that increases the infiltration capacity of pervious areas compared to the pre-project conditions.*	☒	☐
Describe: Project will collect onsite flows and convey to a subsurface infiltration chamber.		
3. *Project discharges directly or via a storm drain to a sump, lake, area under tidal influence, into a waterway that has a 100-year peak flow (Q_{100}) of 25,000 cfs or more.*	☐	☒
Describe: Project does not discharge to a receiving water with these conditions.		
4. *Project discharges directly or via a storm drain into concrete or otherwise engineered (not natural) channels (e.g., channelized or armored with rip rap, shotcrete, etc.), which, in turn, discharge into receiving water that is not susceptible to hydromodification impacts.*	☒	☐
Describe: All three subsurface basins have been designed to storm volume that meter the discharge rate to the allowable flow rate of 0.77 ft3/s per acre which meets the criteria provided by LACDPW for connection to existing 69-inch RCP in Cypress St.		

HYDROMODIFICATION ANALYSIS

The project is exempt from Hydromodification Control Measures.

1.3. PROPERTY OWNERSHIP/MANAGEMENT

- Project to be developed with a fully operational Home Owner's Association for ownership, management and maintenance purposes of stormwater devices.

OWNER:

PKL Investments, LLC
2863 Maricopa Street
Torrance, CA 90503
(714) 738-0828

2. BEST MANAGEMENT PRACTICES (BMPS)

2.1. SITE DESIGN

85TH PERCENTILE, 24-HOUR STORM DEPTH	1.00 inch Refer to Attachment "A" for 85th percentile Isohyetal map.
SITE DESIGN	The project site will collect the onsite flows via curb and gutters, catch basins and subsurface storm drain. Pretreatment to be provided for identified pollutants of concern associated with proposed land use type via Stormexx Clean Catch Basin Inserts at (8) identified inlets upstream of basins. The onsite flows will be conveyed to three proposed subsurface basins within the project site. The subsurface systems have been designed to allow the DCV to infiltrate into the in-situ soils via perforated aluminized steel type 2 CMPs. Geotechnical reports indicate that the project has infiltration rates that range from 1.3 inches/hour to 3.3 inches/hour. The lower halfs of the basin systems will be used solely to impound the WQ volume and promote groundwater infiltration. Site design principles outlined in County of Los Angeles LID Standards Manual were applied where applicable. Site planning included all design criteria identified in the manual. Site planning considerations for Protection/Restoration of Natural Areas and Minimization of Land Disturbance were not applicable. Project will also decrease impervious surface area when compared to existing conditions.

BMP LIST

DMA DESIGNATION	SQUARE FOOTAGE (SF)	ACREAGE (AC)	STORM WATER QUALITY DESIGN VOLUME (SWQDV, CF)	STORM WATER QUALITY DESIGN FLOWRATE (SWQDQ, CFS)	BMP TYPE	MINIMUM BMP SIZE	BMP SIZE PROVIDED
1	127,568	2.93	7,002	0.4849	96" CMP Infiltration Subsurface Basin	Length of 96" CMP =100'	Single CMP Basin
2	164,344	3.77	8,556	0.5607	96" CMP Infiltration Subsurface Basin	Length of 96" CMP = 118'	Double CMP Basins

DMA Designation	Square Footage (SF)	Acreage (Ac)	Storm Water Quality Design Volume (SWQDv, CF)	Storm Water Quality Design Flowrate (SWQDq, CFS)	BMP Type	Minimum BMP Size	BMP Size Provided
3	52,874	1.21	2,746	0.2318	96" CMP Infiltration Subsurface Basin	Length of 96" CMP = 80'	Single CMP Basin

2.2. BMP Selection

2.2.1. Infiltration BMPs

Name	Included
Bioretention without underdrains	☐
Infiltration Trench	☐
Infiltration Basin	☐
Drywell	☐
Proprietary Subsurface Infiltration Gallery	☒
Permeable Pavement (concrete, asphalt, pavers)	☐
Other:	☐
Other:	☐

Description	The proposed perforated 96" CMPs that make up the subsurface infiltration basin BMP systems are feasible from a geotechnical viewpoint as tested infiltration rates exceed the required minimum 0.3 inch/hour for onsite soils. Infiltration rates that range from 1.3 inches/hour to 3.3 inches/hour used for the design of the onsite infiltration. Additional testing of final infiltration locations to be utilized at design phase. Testing provided in Attachment "B" Infiltration Test Report is sufficient to understand infiltration potential. Refer to Attachment B for Infiltration Test Report
Calculations	Attachment A – "Post-Project Inlet Hydrology Map" Attachment A – "Subsurface Basin Typical Section" Attachment B – "Infiltration Test Report" *Refer to Hydrology & Hydraulic Study For Tract Map No. 82315

BMP POLLUTANT REMOVAL EFFECTIVENESS

BMP Pollutant Removal Effectiveness[1]

Pollutant of Concern	Harvest and Use [9]	Infiltration BMPs[3]	Bioretention	Biofiltration with Partial Infiltration	Biofiltration with No Infiltration	Extended Detention Basins [2]	Sand Filter Basin[8]
Sediment	H	H	H	H	H	M	H
Nutrients	H	H	H	H/M[5]	M/L[6]	M/L[4]	M
Trash	H	H	H	H	H	H	H
Metals	H	H	H	H	H	M	M[7]
Bacteria	H	H	H	H	M	L	M
Oil & Grease	H	H	H	H	H	M	H
Organic Compounds	H	H	H	M	M	L	H
Pesticides and Herbicides	H	H	H	M	M	L	M

Abbreviations:

L: Low removal efficiency M: Medium removal efficiency H: High removal efficiency U: Unknown

Notes:

(1) Periodic performance assessment and updating of this table has occurred based on updated information from studies from the District, CASQA, Caltrans, the International BMP Database, and others. These effectiveness ratings are bases on the specific BMP designs incorporated into this manual. Effectiveness ratings assume operation of a given BMP in isolation. If BMPs are used in series the overall pollutant removal effectiveness may be increased. Where direct data are not available to describe the performance rating of a certain BMP/pollutant combination, professional judgement was applied based on evaluation of unit operations and processes of BMPs and the associated unit operations and processes that are effective for pollutant removal.

(2) Effectiveness based upon total 72-hour drawdown time.

(3) Includes infiltration basins, infiltration trenches, and permeable pavements without underdrains.

(4) Medium for Phosphorous, Low for Nitrogen.

(5) Nutrient removal is High if Bioretention Soil Media is formulated according to requirements in Fact Sheet 3.8 Bioretention Soil Media. Otherwise nutrient removal efficiency is Medium.

(6) Nutrient removal efficiency is Medium if Bioretention Soil Media is formulated according to requirements in Fact Sheet 3.8 Bioretention Soil Media. Otherwise nutrient removal efficiency is Low. Medium if the standard Bioretention Soil Media is used. If a nutrient sensitive Bioretention Soil Media is used, removal efficiency is High.

(7) High if specialized media targeting metals is used.

(8) Considered to be a Treatment Control BMP. See the WQMP to determine if this BMP can be used.

(9) Cisterns, when associated with an adequate and reliable (year-round) demand for non-potable use of captured storm water (see the applicable WQMP for any specific requirements), have a High effectiveness at removing all pollutants from stormwater runoff. If there is inadequate demand to reliably drain the cistern through non-potable use throughout the year, pollutant removal effectiveness will be low.

References:

Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs) in South Orange County. (2017)

International Stormwater Best Management Practices (BMP) Database 2014 Performance Summaries. http://www.bmpdatabase.org/Docs/2014%20Water%20Quality%20Analysis%20Addendum/BMP%20Database%20Categorical_StatisticalSummaryReport_December2014.pdf

International Stormwater Best Management Practices (BMP) Database 2016 Performance Summaries. http://www.bmpdatabase.org/Docs/03-SW-1COh%20BMP%20Database%202016%20Summary%20Stats.pdf

Strecker, E.W., W.C Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical Assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

Oil and grease, Organics, and Trash and Debris based on review of unit operations and processes; comprehensive dataset not generally available. BMP must include design elements
to address pollutants of concern.

2.2.2. RAINWATER HARVEST AND USE BMPS

NAME	INCLUDED
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

DESCRIPTION	Project able to fully infiltrate/retain the Stormwater Quality Design Volume onsite via subsurface basins.
CALCULATIONS	n/a

2.2.3. ALTERNATIVE COMPLIANCE BMPS

BIOFILTRATION BMPS

(If Infiltration BMPs and Rainwater Harvest and Use BMPs are Infeasible)

NAME	INCLUDED
Bioretention with underdrains (i.e. planter box, rain garden, etc.)	☐
Constructed Wetland	☐
Vegetated Swale	☐
Vegetated Filter Strip	☐
Tree-Well Filter	☐
Other:	☐
Other:	☐

DESCRIPTION	n/a
CALCULATIONS	n/a

OFFSITE BMPS

(If Infiltration BMPs, Rainwater Harvest and Use BMPs, and Biofiltration BMPs are Infeasible)

NAME	INCLUDED
Offsite Infiltration	☐
Ground Water Replenishment Projects	☐
Offsite Project - Retrofit Existing Development	☐
Regional Storm Water Mitigation Program	☐
Other:	☐
Other:	☐

DESCRIPTION	n/a
CALCULATIONS	n/a

2.2.4. TREATMENT CONTROL BMPS

NAME	INCLUDED
Media Filter	☐
Filter Insert	☒
CDS Unit	☐
Other:	☐
Other:	☐

DESCRIPTION	Stormexx Clean Catch Basin Filter Inserts to be installed at all roadway/parking catch basins as indicated on LID Site Plan. The inserts should be inspected during each season before and after rain events to ensure that the insert filter assembly is ready to accept and treat stormwater run-off. Keep the grate and area within 6' of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. Periodic visual inspections involve looking through the grate to see if any standing water exists. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6" to 8" above bottom of the 24" housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary. Refer to Attachement "G" for BMP Technical Information Sheets.

2.2.5. HYDROMODIFICATION CONTROL BMPS

NAME	INCLUDED
Infiltration System	☐
Above-ground Cistern	☐
Above-ground Basin	☐
Underground Detention	☐
Other:	☐
Other:	☐

DESCRIPTION	The project is exempt from Hydromodification Control Measures, see Section 1.3
CALCULATIONS	n/a

2.2.6. NON-STRUCTURAL SOURCE CONTROL BMPS

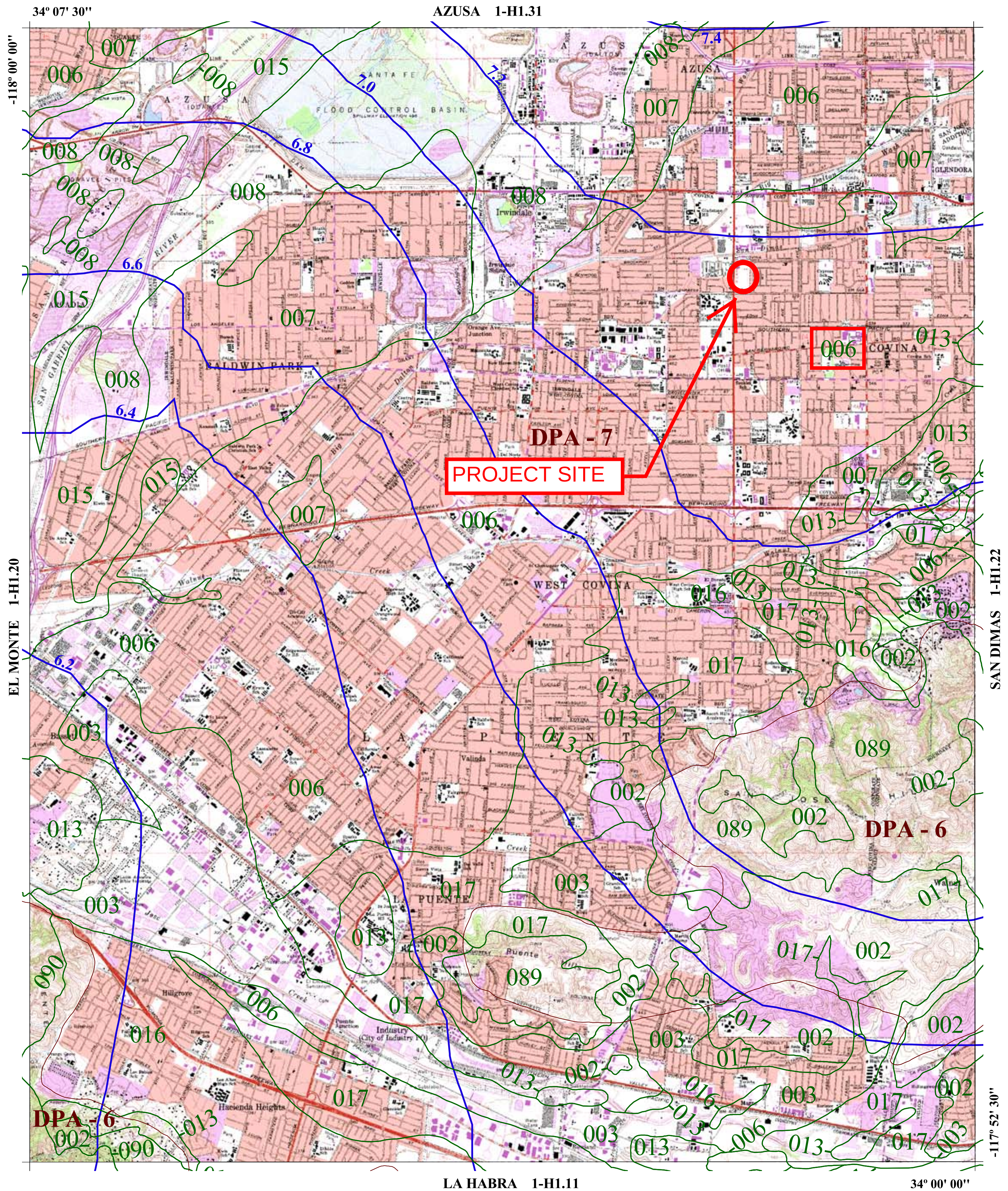
NAME	CHECK ONE	
	Included	**Not Applicable**
Education for Property Owners, Tenants and Occupants	☒	☐
Activity Restrictions	☒	☐
Common Area Landscape Management	☒	☐
Common Area Litter Control	☒	☐
Housekeeping of Loading Docks	☐	☒
Common Area Catch Basin Inspection	☒	☐
Street Sweeping Private Streets and Parking Lots	☒	☐

2.2.7. STRUCTURAL SOURCE CONTROL BMPS

NAME	CHECK ONE	
	Included	**Not Applicable**
(S-1) Storm Drain Message and Signage	☒	☐
(S-2) Outdoor Material Storage Area	☐	☒
(S-3) Outdoor Trash Storage & Waste Handling Area	☒	☐
(S-4) Outdoor Loading/Unloading Dock Area	☐	☒
(S-5) Outdoor Vehicle/Equipment Repair/Maintenance Area	☐	☒
(S-6) Outdoor Vehicle/Equipment/Accessory Washing Area	☐	☒
(S-7) Fuel and Maintenance Area	☐	☒
(S-8) Landscape Irrigation Practices	☒	☐
(S-9) Building Materials Selection	☒	☐
(S-10) Animal Care and Handling Facilities	☐	☒
(S-11) Outdoor Horticulture Areas	☐	☒

Attachment A

Calculations



016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

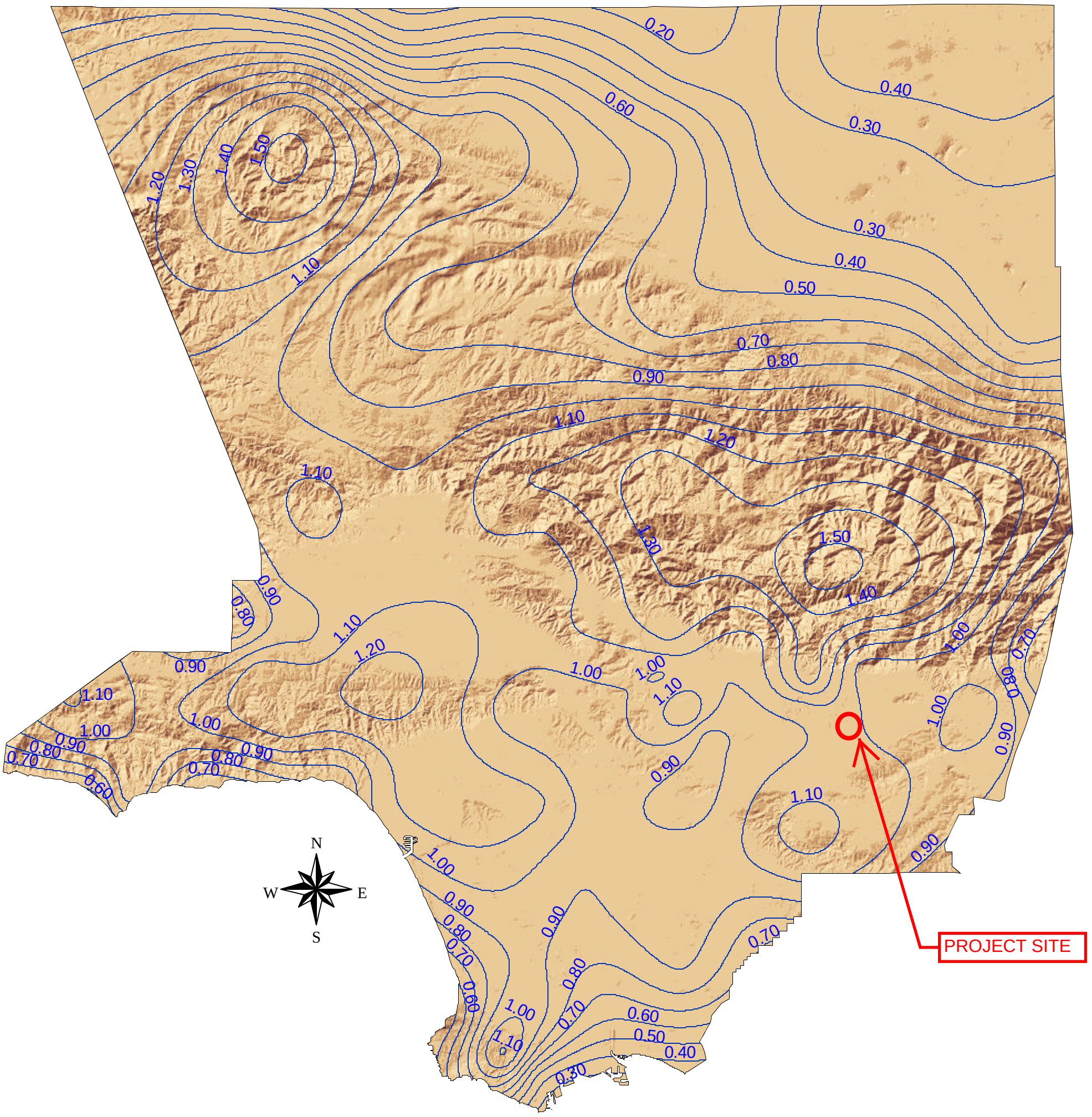
25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

BALDWIN PARK
50-YEAR 24-HOUR ISOHYET

1-H1.21

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

85th Percentile 24-hr Rainfall Isohyetal Map



Peak Flow Hydrologic Analysis

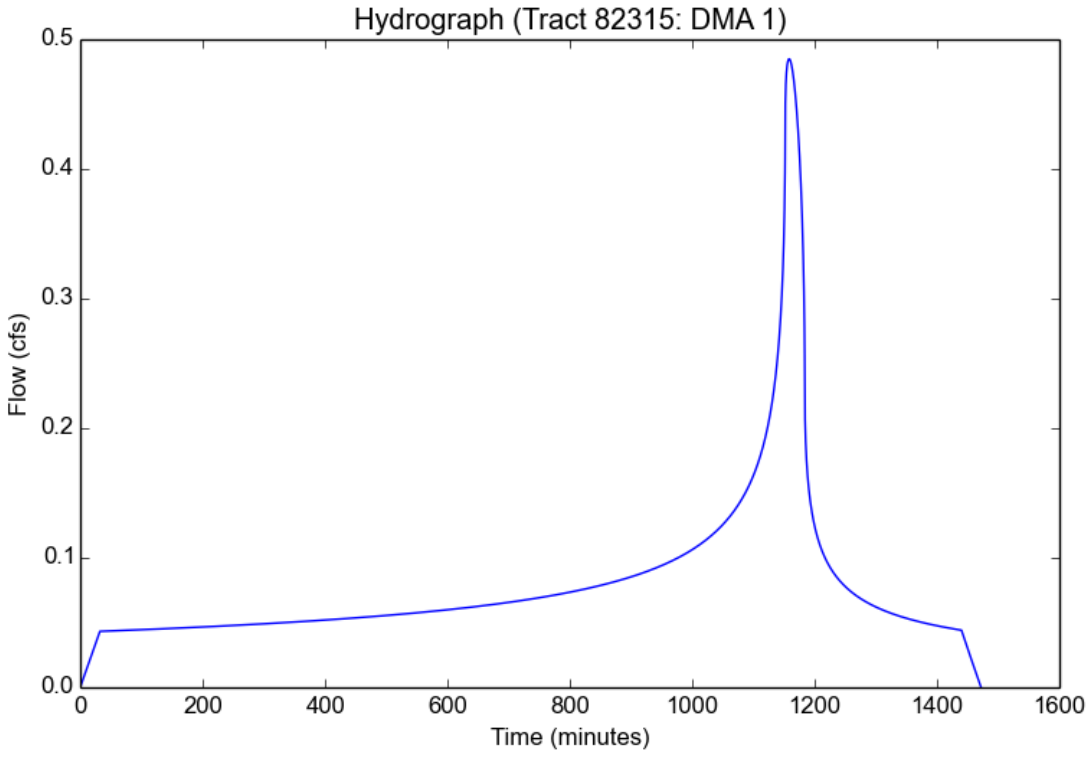
File location: N:/JN503 - Covina/LID/Tract 82315 - DMA 1.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	Tract 82315
Subarea ID	DMA 1
Area (ac)	2.929
Flow Path Length (ft)	600.0
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	1.0
Percent Impervious	0.705
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.0
Peak Intensity (in/hr)	0.2493
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.664
Time of Concentration (min)	32.0
Clear Peak Flow Rate (cfs)	0.4849
Burned Peak Flow Rate (cfs)	0.4849
24-Hr Clear Runoff Volume (ac-ft)	0.1607
24-Hr Clear Runoff Volume (cu-ft)	7001.5732



Peak Flow Hydrologic Analysis

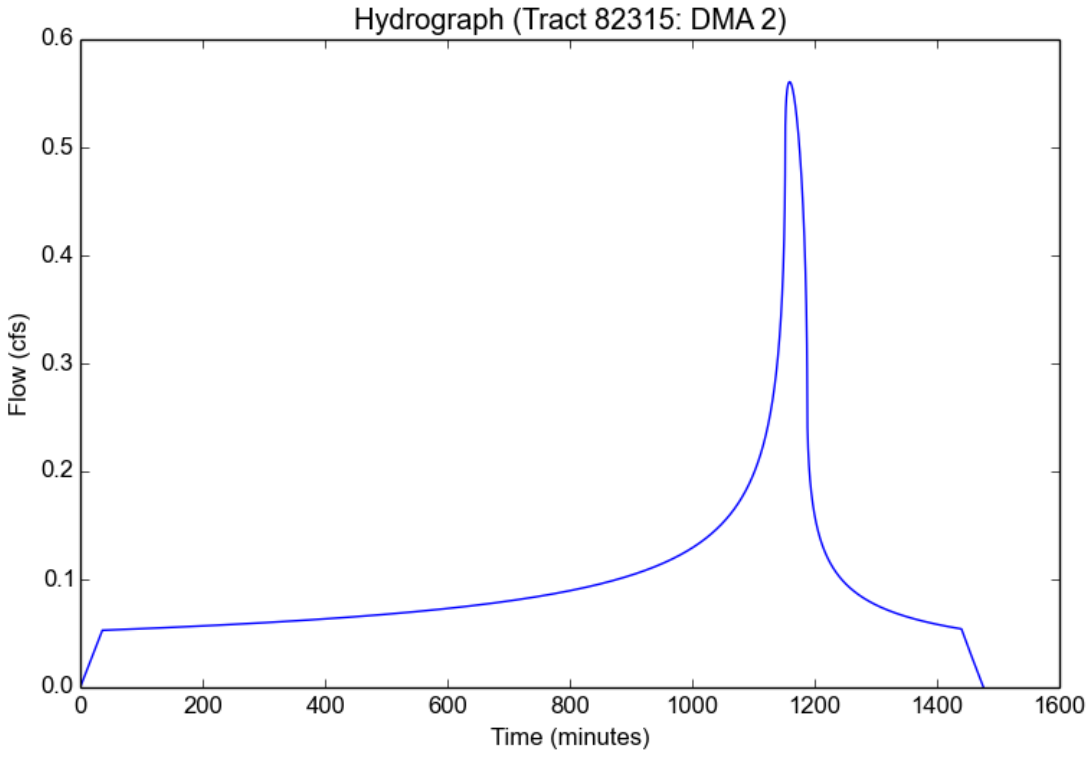
File location: N:/JN503 - Covina/LID/Tract 82315 - DMA 2.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	Tract 82315
Subarea ID	DMA 2
Area (ac)	3.77
Flow Path Length (ft)	565.5
Flow Path Slope (vft/hft)	0.0056
85th Percentile Rainfall Depth (in)	1.0
Percent Impervious	0.663
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.0
Peak Intensity (in/hr)	0.2359
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6304
Time of Concentration (min)	36.0
Clear Peak Flow Rate (cfs)	0.5607
Burned Peak Flow Rate (cfs)	0.5607
24-Hr Clear Runoff Volume (ac-ft)	0.1964
24-Hr Clear Runoff Volume (cu-ft)	8555.9308



Peak Flow Hydrologic Analysis

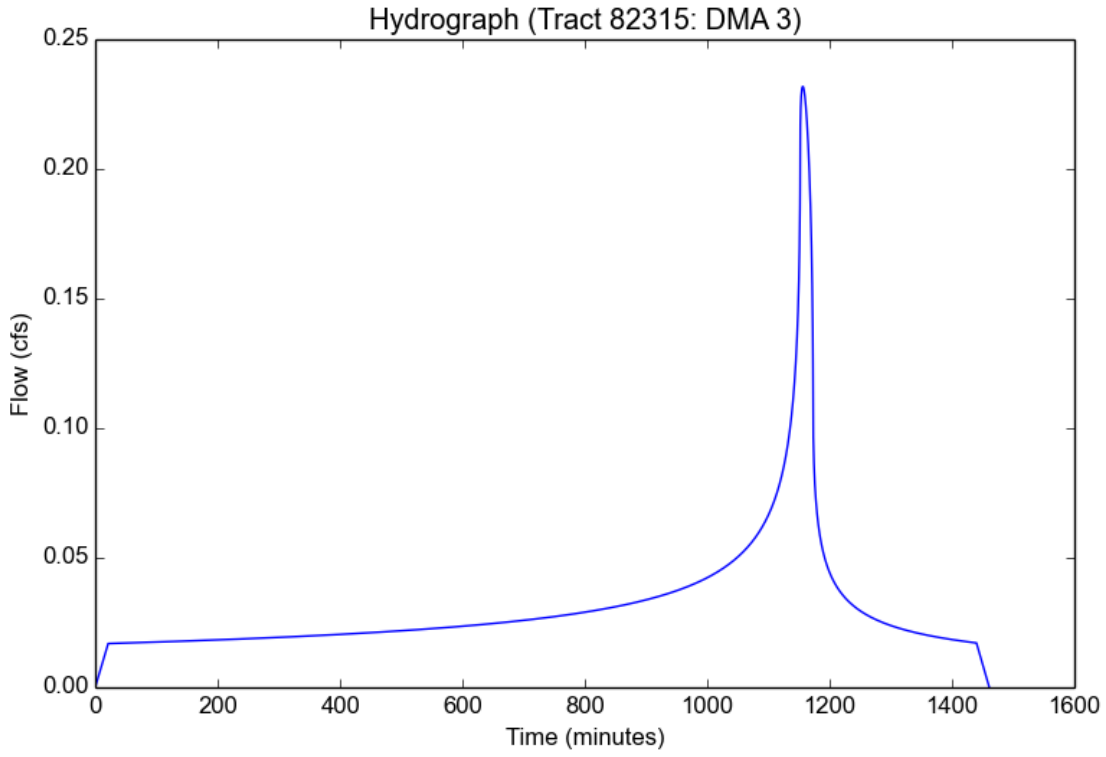
File location: N:/JN503 - Covina/LID/Tract 82315 - DMA 3.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	Tract 82315
Subarea ID	DMA 3
Area (ac)	1.21
Flow Path Length (ft)	259.6
Flow Path Slope (vft/hft)	0.0069
85th Percentile Rainfall Depth (in)	1.0
Percent Impervious	0.663
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

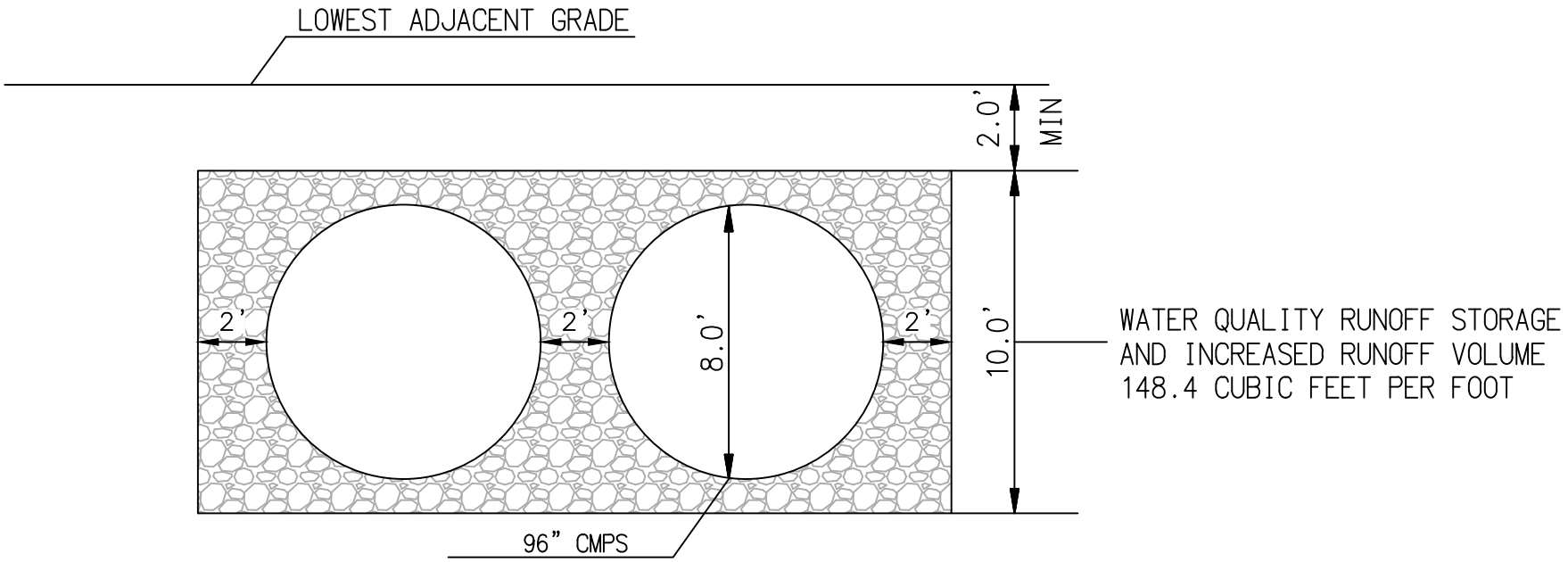
Modeled (85th percentile storm) Rainfall Depth (in)	1.0
Peak Intensity (in/hr)	0.3039
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6304
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	0.2318
Burned Peak Flow Rate (cfs)	0.2318
24-Hr Clear Runoff Volume (ac-ft)	0.063
24-Hr Clear Runoff Volume (cu-ft)	2746.0378



TRACT MAPNO 82315

IN THE CITY OF COVINA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

DOUBLE 96-INCH SUBSURFACE BASIN



DOUBLE SUBSURFACE BASIN - 96" CMP SYSTEM TYPICAL CROSS SECTION

FIGURE 2

JLC Engineering & Consulting, Inc.

41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

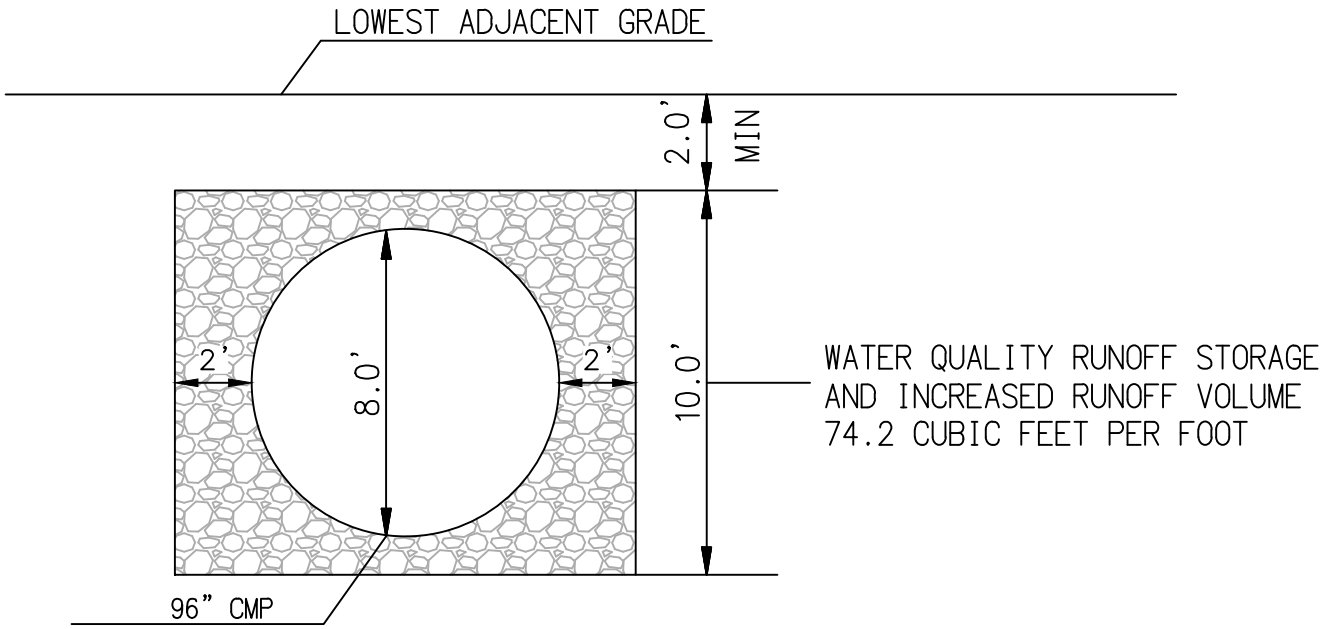
TRACT MAP NO 82315

DOUBLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

TRACT MAPNO 82315

IN THE CITY OF COVINA, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

SINGLE 96-INCH SUBSURFACE BASIN



SINGLE SUBSURFACE BASIN - 96" CMP SYSTEM TYPICAL CROSS SECTION

FIGURE 3

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
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PH. 951.304.9552 FAX 951.304.3568

TRACT MAP NO 82315

SINGLE 96-INCH SUBSURFACE BASIN TYPICAL SECTION

Attachment B

Geotechnical Investigation

GeoConcepts INC
Geology - Geotechnical Engineering

PRELIMINARY GEOTECHNICAL ENGINEERING INVESTIGATION

Proposed Residential and Commercial Developments

1000 North Azusa Avenue

Covina, California

for

PKL Investments, LLC

2863 Maricopa Street

Torrance, California 90503

Project 5071

December 7, 2015

www.GeoConceptsInc.com
14428 Hamlin Street, #200, Van Nuys, CA 91401 + (818) 994-8895 Office + (818) 994-8599 Fax

PRELIMINARY GEOTECHNICAL ENGINEERING INVESTIGATION

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APPENDICES

INTRODUCTION

This report presents the results of a Preliminary Geotechnical Engineering Investigation on a portion of the subject property. The purpose of this investigation has been to ascertain the subsurface conditions pertaining to the proposed project. The work performed for the project included reconnaissance mapping, description of earth materials, obtaining representative samples of earth materials, laboratory testing, engineering analyses, and preparation of this report. Results of the project include findings, conclusions, and appropriate recommendations.

SCOPE

The scope of this investigation included the following:

- Review of five (5) borings. Explorations were backfilled with the excavated materials but not compacted.
- Preparation of the enclosed Plot Map (see Appendix I).
- Sampling of representative earth materials, laboratory testing, and engineering analyses (see Appendix II).
- Review of referenced materials (see Appendix V).
- Presentation of findings, conclusions, and recommendations for the proposed project.

Delta Surveying and Mapping prepared the topographic base map utilized in this investigation.

The scope of this investigation is limited to the project area explored as depicted on the Plot Map. This report is not a comprehensive evaluation of the entire property. This report has not been prepared for use by other parties or for purposes other than the proposed project. GeoConcepts, Inc. should be consulted to determine if additional work is required when our work is used by others or if the scope of the project has changed. If the project is delayed for more than one year, this office should be contacted to verify the current site conditions and to prepare an update report.

PROPOSED DEVELOPMENT

It is our understanding that the site will be developed with single-family residences and a commercial structure. Anticipated foundations will range from 1 to 2 kips per lineal foot and 20-40 kips for column foundations. The proposed development is depicted on the enclosed Plot Map.

Grading will consist of conventional cut and fill methods. Final plans have not been prepared and await the conclusions and recommendations of this investigation. These plans should be reviewed by GeoConcepts, Inc. to ensure that our recommendations have been followed.

SITE DESCRIPTION

Location and Description

Access to the property is via North Azusa Avenue from West Cypress Street (see Location Map in Appendix I). The site is developed with a parking area and a vacant grocery store/commercial development.

The pad has a light growth of vegetation consisting of grasses, lawn areas, shrubs and trees.

Adjacent sites to the southwest, east, and north are developed with various restaurants, single family residences, and a U-Haul facility with other single family residences with North Azusa Avenue to the west and West Cypress Street to the south. Adjacent structures to the north, southwest, and east are than (10) feet from the property line.

Drainage

Surface water at the site consists of direct precipitation onto the property Much of this water drains as sheet flow down descending slopes to low-lying areas, area drains, paved swale drains, offsite and/or to the street. The residence was not been provided with roof gutters and downspouts. Portions of the undeveloped areas are serviced by an irrigation system.

Groundwater

No active surface groundwater seeps or springs were observed on the subject site. The subsurface exploration did not encounter groundwater to a depth of (31) feet. Based on the Seismic Hazard Zone Report by the California Geological Survey (formerly Division of Mines and Geology), the depth to historical high groundwater level is about one-hundred eighty (180) feet below the surface. Seasonal fluctuations of groundwater levels may occur by varying amounts of rainfall, irrigation and recharge.

FIELD EXPLORATION

The scope of the field exploration was developed based on the preliminary plans of the proposed development available at the time of the exploration and was limited to the area of the proposed development. The locations of the explorations are depicted on the Plot Map. The field exploration was limited by existing structures, hardscape, and/or underground utilities on the site.

The field exploration of the site was conducted on November 6, 2014. The geotechnical conditions were mapped by a representative of this office (refer to Exploration Logs). Subsurface exploration was performed by a drill rig into the underlying earth materials. Explorations were excavated to a maximum depth of 31 feet. All explorations were backfilled and tamped upon completion of down-hole observation. However, some settlement within exploration areas should be anticipated.

Detailed descriptions of the earth materials encountered during the field exploration are provided in the Boring Logs in Appendix I.

Undisturbed and bulk samples representative of the earth materials were obtained and transported to our laboratory. Undisturbed Modified California (MC) samples were obtained within the explorations through the use of a thin-walled steel sampler with successive blows of a 140 pound drop hammer dropped thirty inches (30"). MC samples were retained in brass rings of two and one-half inches (2½") in diameter and one inch (1") in height. The results of the laboratory testing and a summary of the test procedures are included within Appendix II.

SUMMARY OF FINDINGS

Previous Work

Based on the Los Angeles County Building Permits Viewer, the subject property was developed circa 1991.

Stratigraphy

The site is underlain by Quaternary (Q) earth materials and artificial fill. The earth materials encountered on the subject property are briefly described below. Approximate depths and more detailed descriptions are given in the enclosed Exploration Logs (see Appendix I).

Artificial Fill (Af)

Artificial fill was encountered on the subject site. Fill materials were presumably placed during pad grading and construction of the commercial development. Fill was encountered in two of the borings with a thickness of (1.5) feet. Contact between the fill and the underlying soil was exposed within the boring. Fill generally consists of silty sand with clay binder with frequent rock and glass fragments that generally range between (1/4) and (1/2) inches in length.

Quaternary Alluvium (Qal)

Alluvial deposits occupy the site. Alluvium is weathered bedrock material and sediments that have been eroded from natural slopes and deposited in generally flat lying areas. Alluvium primarily consists of light brown to tan, moderately dense to dense, silty sand to coarse granular sands with occasional to frequent clasts that generally range between (1/4) and (1) inches in length. These deposits were encountered within all the borings ranging to the depth of the exploration.

Excavation Characteristics

Subsurface exploration was performed through the use of a hollow-stem drill rig excavating into generally fill and alluvium. Excavation difficulty is considered normal within the earth materials encountered and should not be limited to consideration of rippability of the earth material. Cohesionless sandy material, although easy to remove, may be subject to sloughing and caving. Therefore difficulty may be encountered maintaining an open excavation. Fine grained materials such as clays and silts may increase in density with depth due to overburden pressure. Thus, difficulty excavating into the material may increase with depth.

Landslides

Landslides are a mass wasting phenomenon in mountainous and hillside areas which include a wide range of movements. In Southern California common slope movements include shallow surficial slumps and flows, deep-seated rotational and translational bedrock failures, and rock falls. Landslides occur when the stability of the slopes change to an unstable condition resulting from a number of factors. Common natural factors include the physical and/or chemical weathering of earth materials, unfavorable geologic structure relative to the slope geometry, erosion at the toe of a slope, and precipitation. These factors may be further aggravated by human activities such as excavations, removal of lateral support at the toe of a slope, surcharge at the top of a slope, clearing of vegetation, alteration of drainage, and the addition of water from irrigation and leaking pipes.

The subject site is relatively flat with very little topography which precludes the potential for landslides and/or other hazards typically associated with hillside properties.

Seismic Hazards

Earthquake Faults

The Alquist-Priolo Earthquake Fault Zoning (AP) Act was passed into law following the destructive February 9, 1971 San Fernando earthquake. The intent of the Act is to increase public safety by reducing the siting of most structures for human occupancy across an active fault. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. The property is not located within an Alquist-Priolo Earthquake Fault Zone. The general locations of major faults within Southern California are depicted on a fault map provided by the USGS in Appendix I.

Active Faults

The following active faults are capable of producing seismic waves (ground shaking) on the subject property. A summary description of the closest active faults and potentially active faults to the site are described herein and labeled by number on the map below. An active fault, as defined by the State Mining and Geology Board, is one, which has "had surface displacement within Holocene time (about the last 11,000 years)".

The San Andreas Fault zone (42) is the dominant active fault in California. Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 150-year intervals on the southern San Andreas Fault. It consists of numerous subparallel faults of varied lengths in a zone generally 0.3 to 1.5 km wide in Southern California. The dip of the fault is near vertical and the sense of motion is right lateral. Historically, the 1857 Fort Tejon earthquake with an estimated magnitude of 7.9 ruptured the ground surface from the vicinity of Cholame (near Paso Robles) to somewhere between the Cajon Pass and San Gorgonio Pass (Wrightwood), approximately 200 miles. Studies of offset stream channels indicate that as much as (29) feet of movement occurred in 1857. The fault extends from the Gulf of California northward to the Cape Mendocino area where it continues along the ocean floor, approximately 750 miles in length.

The Northridge earthquake occurred on January 17, 1994, in the San Fernando Valley. The epicenter was about 1 mile south-southwest of Northridge at a focal depth of 12 miles. The surface wave magnitude was issued by the National Earthquake Information Center at Mw=6.7. This event occurred on a previously unrecognized south-dipping blind reverse fault without surface rupture. This earthquake produced the strongest ground motions ever instrumentally recorded in an urban setting in North America. Damage was wide-spread with sections of major freeways collapsed include some parking structures and office buildings. Common surface disruptions included buckled curbs and sidewalks, fissured concrete and asphalt, and rupture of utility lines which are generally aligned in northwest and east-west directions. Shattered ridges were reported along Mulholland Drive in the Sherman Oaks area, consisting of intense ground disturbances associated with strong vibratory ground motions within the north trending ridges underlain by shale of the Lower Modelo formation.

The Whittier-Elsinore fault zone (60) consists of several subparallel, overlapping and en echelon fault strands in a zone up to 1.2 km wide. It extends nearly 125 miles from the Mexican border to the northern edge of the San Fernando Valley. Seismicity includes the Whittier Narrows earthquake of October 1, 1987 with a magnitude of 5.9 and an epicenter in the city of Rosemead. This earthquake occurred on a previously unknown and concealed thrust fault. There was no reported surface rupture from the earthquake. Also, numerous close and scattered small earthquakes have occurred in historic time near and along the fault.

The San Fernando fault (45) consists of five major en echelon strands at least 9.5 miles in length. The "San Fernando" earthquake of February 9, 1971 produced a magnitude of Mw 6.5 at a depth of 8.4 km along an east west trending reverse fault with a northerly dip. The length of the surface rupture was about 9.5 miles and ground shaking lasted for approximately 60 seconds. The earthquake ruptured the northwestern end of the Sierra Madre Fault zone forming the San Fernando Fault. Major damage included the Olive View and Veterans Administration Hospitals and collapse of freeway overpasses. Landslides occurred in the Upper Lake area of Van Norman Lakes. Additionally the Van Norman Dam and the Pacoima Dam were severely damaged.

The eastern portion of the Santa Susana fault (52) ruptured during the 1971 San Fernando Earthquake. The Santa Susana fault consists of several strands in a zone as wide as 1 km. It generally strikes from north 75 degrees west to north 50 degrees east and dips to the north.

The fault is a high angle reverse fault. The fault appears to have been generated by northeast-southwest oriented compressional stress.

The Newport-Inglewood fault zone (31) consists of several strands that extend from offshore by Laguna Beach to either merge with or be truncated by the Malibu-Santa Monica fault zone near Beverly Hills. The fault has a length of about 45 miles. It was the source of the "Long Beach" earthquake, which occurred on March 10, 1933 with a magnitude of 6.3. Numerous small earthquakes have occurred in historic time along and near the fault zone. The fault zone is easily observed by an alignment of hills and mesas including Cheviot Hills, Baldwin Hills, Rosecrans Hills, Dominguez Hills, Signal Hill, Reservoir Hill, Alamitos Heights, Landing Hill, Bolsa Chica Mesa, and Newport Mesa.

In June 1995, two portions of the Malibu Coast fault zone (27) were reclassified as active fault zones by the State of California. On August 16, 2007, the fault zone near the east side of Malibu Bluff Park was removed from the State of California Earthquake Fault Zone map by the State of California. The east west trending Malibu Coast fault consists of several subparallel strands in a zone as wide as 0.5 km, with a length of at least 17 miles. It strikes east west and dips (45) to (80) degrees to the north. The Malibu Coast fault has the potential to produce a large Maximum Credible Peak and Repeatable Acceleration on the subject property. The duration of the Malibu Coast fault is estimated at (11) seconds assuming fault end nucleation and unidirectional rupture propagation, (Bolt, 1981). The Malibu Coast fault is thought to be part of other faults such as the Santa Monica fault and Hollywood fault that separate the Transverse Ranges on the north from the Peninsula Range on the south. Two Malibu Earthquakes occurred with Magnitudes of M_L 5.2 and M_L 5.0 on January 1, 1979 and January 18, 1989, respectively. It was reported that only minor damage occurred in the areas closest to the epicenter.

The Hollywood fault zone (22) extends along the base of the Santa Monica Mountains. This fault was added to the list of active fault by the State of California in 2014. Generally, the Hollywood fault extends eastward for a distance of 15 km through Beverly Hills, West Hollywood, and Hollywood to the Los Angeles River. The fault is primarily expressed at the ground surface by scarp-like features. This is a left–reverse fault with an estimated slip rate between 0.33 mm/yr and 0.75 mm/yr, (Petersen and Wesnousky 1994).

The Raymond fault (39) is a combination fault with reverse and left slip movement that acts as a groundwater barrier within the densely populated San Gabriel Valley. The activity of the fault is attested to by the numerous geomorphic features found along its entire length of approximately 14 miles. Scattered small earthquakes have occurred north of the fault trace. It may be the source of the 1855 Los Angeles earthquake. The Raymond fault is an east-trending fault made up of other faults such as the Hollywood and Santa Monica faults that separate the Transverse Ranges on the north form the Peninsula Range on the south.

The Sierra Madre fault zone (53) is often divided into five main segments; Vasquez Creek fault, Clamshell fault (10), Sawpit Canyon fault (10), Duarte fault and the Cucamonga fault (14). The Sierra Madre earthquake of June 28, 1991 (Mw5.8) was in the San Gabriel Mountains. An estimated 33.5 million dollars of damage has been reported. The Sierra Madre fault zone is about 75 km long. It's a thrust fault system along the south edge of the San Gabriel Mountains. The east end of the Sierra Madre fault zone intersects the San Jacinto fault and the San

Andreas Fault. The 1971 San Fernando earthquake occurred on the San Fernando-Sunland segment of the Sierra Madre fault zone.

The San Gabriel fault (46) consists of several en echelon fault strands in a zone approximately 0.5 km wide, with a length of about 90 miles. The fault trends northwestward and subparallel to the San Andreas Fault. As of March 1, 1988, a portion of the Newhall segment of the fault zone was reclassified as an active fault. Fault activity has been dated between 1550 and 3500 years before present within the Newhall segment. The youngest ground rupture event has broken alluvial beds to within five feet of the ground surface. Geologic evidence suggests 38 miles of right lateral offset has occurred between 14 million and 3 million years ago and may have functioned as an ancestral branch of the San Andreas Fault. Recent studies suggest that the major strike slip movement has become inactive and dip slip movement is active at the present time.

Potentially Active Faults

A potentially active fault, as defined by the State Mining and Geology Board, is one, which has had surface displacement during Quaternary time (last 1.6 million years). "These faults are those based on available data along which no known historical ground surface ruptures or earthquakes have occurred. These faults, however, show strong indications of geologically recent activity". The following list provides potentially active faults that are capable of producing seismic waves (ground shaking) on the property.

The Santa Monica fault (50) extends east from the coastline in Pacific Palisades through Santa Monica and West Los Angeles and merges with the Hollywood fault. Several local geologists believe portions of the Santa Monica fault zone are active. Currently, it is listed by the State of California as a potentially active fault. Portions of the fault zone may change to "active" and be placed within the Alquist-Priolo Earthquake Fault Zone as additional geologic reports are submitted to the State containing evidence of Holocene activity. The Santa Monica fault consists of one or more fault strands, with a poorly known geometry. Generally, the fault strikes northeast 60 to 80 degrees and dips 45 to 65 degrees northwest at depth with a few near vertical surface traces. The length of the fault is at least 25 miles. The composite local mechanism of fault displacement is a reverse left lateral along the Santa Monica-Hollywood-Raymond fault zone. The Santa Monica and Hollywood faults may be part of a larger fault system that includes Malibu Coast, Raymond and Cucamonga fault system. This fault zone forms the central portion of a major tectonic boundary separating the east west trending Transverse Ranges province to the north from the northwest trending Peninsular Ranges province to the south.

The Benedict Canyon fault zone trends eastward through the Santa Monica Mountains. The fault may be part of the Hollywood-Santa Monica-Raymond fault system. The activity of the fault is based on offsets in groundwater bearing sediments that correlate with steep dipping gravity gradients. The fault extends through Universal City and along the north side of the eastern part of the Santa Monica Mountains.

The Simi fault (54) consists of a single strand that bifurcates at the western end. Generally, it strikes north 70-80 degrees east and dips 60 to 75 degrees north with a length of about 31-km.

The Mission Hills fault (30) is an east west trending fault with a length of about 9 km. The fault is presumed to be a single strand that strikes north 80 degrees east to east west and dips about 80 degrees to the north.

The Chatsworth fault (8) is a reverse fault which juxtaposes Cretaceous Chatsworth formation and Paleocene Martinez formation over Miocene Modelo formation within the San Fernando Valley.

The Palos Verdes Hills fault (35) consists of several en echelon strands locally in a zone as wide as 2 km with a length of 50 miles. It strikes north between 20 and 60 degrees west with dips of 70 degrees to the southwest.

Seismic Effects

During an earthquake there are several primary geologic hazards such as ground rupture, ground shaking, landslides, and liquefaction that can adversely affect property, structures, and improvements. On hillside properties, the potential exists for landsliding from ground shaking which may adversely affect property, structures, and improvements. The State of California has prepared maps that detail areas which may require assessment for ground rupture, landsliding and/or liquefaction. Strong ground shaking is the primary hazard that causes damage from earthquakes and these areas have been zoned with a high level of seismic shaking hazard. The historical earthquake record in Southern California is less than 200 years; therefore, potential damage from a seismic event is not limited areas that have experienced damage in the past. Based on the above discussion, earthquake insurance with building code upgrades is suggested.

There are several active and/or potentially active faults that could possibly affect the site within Los Angeles County. The site is located within Seismic Zone 4. Although all of Southern California is within a seismically active region, some areas have a higher potential for seismic damage than others. The current scientific technology does not provide for accurate prediction of the time, location, or magnitude of an earthquake event.

It should be understood that the following discussion is an evaluation of risk and degree of potential damage to a structure if a fault were to rupture on or near the site and does not imply that a fault may or may not be present beneath the site. An assessment of damage to the structure is based on the Modified Mercalli Intensity Scale which is correlated to observed damage from seismic events. Intensity/damage associated with an earthquake is not directly correlated to magnitude. For a given magnitude of an earthquake, the intensity/damage to a structure may vary depending on the subsurface earth materials, type of fault rupture, hypocenter depth, and local building practices in effect during the construction of a structure.

An evaluation of the seismic effects on a property is designed to provide the client with rational and believable seismic data that could affect the property during the lifetime of the proposed improvements. The minimum design acceleration for a project is listed in the Building Code. It is recommended that the structural design of the proposed project be based on current design

and acceleration practices of similar projects in the area. The project structural designer should review and verify all of the seismic design parameters prior to utilizing the information for the design.

Ground Rupture

Ground rupture is the result of movement from an active fault. A fault is a fracture in the crust of the earth along which rocks on one side have moved relative to those on the other side. No known active fault is mapped on the subject site.

Ground Shaking

Ground shaking caused by an earthquake is likely to occur at the site during the lifetime of the development due to the proximity of several active and potentially active faults. Generally, on a regional scale, quantitative predictions of ground motion values are linked to peak acceleration and repeatable acceleration, which are a response to earthquake magnitudes relative to the fault distance from the subject property. Southern California major earthquakes are generally the result of large-scale earth processes in which the Pacific plate slides northwestward relative to the North American plate at about 2 inches/year.

The potential for lurching, surface manifestations, landslides, and topographic related features from ground/seismic shaking can occur almost anywhere in Southern California. Proper maintenance of properties can mitigate some of the potential for these types of manifestations, but the potential cannot be completely eliminated. Many structures were built before earthquake codes were adopted; others were built according to codes formulated when less was known about the intensity of near-fault shaking. Therefore, the margin of safety is difficult to quantify.

A publicly available computer program provided by the United States Geological Survey (USGS) was utilized for the probabilistic prediction of peak horizontal ground acceleration from digitized design maps of Maximum Considered Earthquake (MCE) ground response. A summary of the seismic design parameters is provided in Appendix III. The project structural designer should verify all of the input parameters and review all of the resulting seismic design parameters prior to utilizing the information for the design.

Earthquake Induced Landslides

The State of California has prepared Seismic Hazard Zone Reports to regionally map areas of potential increased risk of permanent ground displacement based on historic occurrence of landslide movement, local topographic expression, and geological and geotechnical subsurface conditions. The maps may not identify all areas that have potential for earthquake-induced landsliding, strong ground shaking, or other earthquake-related geologic hazards. The subject site is not located within an earthquake-induced landslide hazard zone on the State of California Seismic Hazard Map.

The subject site is relatively flat with very little topography which precludes the potential for landslides and/or other hazards typically associated with hillside properties.

Liquefaction

The State of California has prepared Seismic Hazard Zone Reports to regionally map areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacement. The maps may not identify all areas that have potential for liquefaction, strong ground shaking, and other earthquake and geologic hazards. The subject site is not located within a liquefaction hazard zone on the State of California Seismic Hazard Zone Map.

Liquefaction is a process by which sediments below the water table temporarily lose strength and behave as a viscous liquid rather than a solid. The types of sediments most susceptible are clay-free deposits of sand and silts; occasionally gravel liquefies. Liquefaction can occur when seismic waves, primarily shear waves, pass through saturated granular layers distorting the granular structure, and causing loosely packed groups of particles to collapse. These collapses increase the pore-water pressure between grains if drainage cannot occur. If the pore-water pressure rises to a level approaching the weight of the overlying soil, the granular layer temporarily behaves as a viscous liquid rather than a solid.

In the liquefied condition, soil may deform with little shear resistance; deformations large enough to cause damage to buildings and other structures are called ground failures. The ease with which a soil can be liquefied depends primarily on the looseness of the material, the depth, thickness and areal extent of the liquefied layer, the ground slope and the distribution of loads applied by buildings and other structures.

Liquefaction induced ground deformations will have an effect on the proposed and existing development that can result in significant structural damage, collapse or partial collapse of a structure, especially if there is significant differential settlement or lateral spreading between adjacent structural elements. Even without collapse, significant settlement or lateral spreading could result in significant structural damage including, but not limited to, blocked doors and windows that could trap occupants.

A detailed subsurface analysis can be performed to determine the liquefaction potential on the subject site and provide recommendations to mitigate the effects of liquefaction. A proposal for a detailed analysis will be prepared if requested.

Surface Manifestations

The determination of whether surface manifestation of liquefaction (such as sand boils, ground fissures etc.) will occur during earthquake shaking at a level-ground site can be made using the method outlined by Ishihara (1985). It is emphasized that settlement may occur, even with the absence of surface manifestation. Youd and Garris (1994 and 1995) evaluated the Ishihara method and concluded that the method is not appropriate for level ground sites subject to lateral spreading and/or ground oscillation.

Based upon the depth to groundwater, surface manifestations of liquefaction should not pose any significant hazard to the proposed development provided the recommendations contained within this report are followed and maintained.

Lateral Spreads

Whereas the potential for flow slides may exist at a building site, the degradation in undrained shear resistance arising from liquefaction may lead to limited lateral spreads (of the order of feet or less) induced by earthquake inertial loading. Such spreads can occur on gently sloping ground or where nearby drainage or stream channels can lead to static shear stress biases on essentially horizontal ground (Youd, 1995). At larger cyclic shear strains, the effects of dilation may significantly increase post liquefaction undrained shear resistance. However, incremental permanent deformations will still accumulate during portions of the earthquake load cycles when low residual resistance is available. Such low resistance will continue even while large permanent shear deformations accumulate through a ratcheting effect. Such effects have recently been demonstrated in centrifuge tests to study liquefaction induced lateral spreads, as described by Balakrishnan et al. (1998). Once earthquake loading has ceased, the effects of dilation under static loading can mitigate the potential for a flow slide.

It is clear from past earthquakes that damage to structures can be severe, if permanent ground displacements on the order of several feet occur. However, during the Northridge earthquake significant damage to building structures (floor slab and wall cracks) occurred with less than one (1) foot of lateral spread. The complexities of post-liquefaction behavior of soils noted above, coupled with the additional complexities of potential pore water pressure redistribution effects and the nature of earthquake loading on the sliding mass, lead to difficulties in providing specific guidelines for lateral spread evaluations.

Based upon the depth to groundwater, liquefaction lateral spreads should not pose any significant hazard to the proposed development.

Seismically Induced Settlements

Seismic settlement occurs when cohesionless soils densify as result of ground shaking. Typically seismically induced settlement is greatest in loose cohesionless sands. Lee and Albaisa (1974) and Yoshimi (1975) studied the volumetric strains (or settlements) in saturated sands due to dissipation of excess pore pressures generated in saturated granular soils by the cyclic ground motions. The volumetric strain, in the absence of lateral flow or spreading, results in settlement. Liquefaction-induced settlement could result in collapse or partial collapse of a structure, especially if there is significant differential settlement between adjacent structural elements. Even without collapse, significant settlement could result in blocked doors and windows that could trap occupants.

The soils encountered at the subject site consist of dense sand with silt to silty sand. Although the magnitude of the seismically induced settlement is not readily predicted, based upon the depth to groundwater, seismically induced settlement should not pose any significant hazard to the proposed development provided the recommendations contained within this report followed and maintained.

CONCLUSIONS

1. Based on the results of this investigation and a thorough review of the proposed development, as discussed, the project is suitable for the intended use providing the following recommendations are incorporated into the design and subsequent construction of the project. Also, the development must be performed in an acceptable manner conforming to building code requirements of the controlling governing agency.

2. Based on the State of California Seismic Hazard Maps, the subject site is not located within a liquefaction or earthquake-induced landslide hazard zone.

3. The SITE CLASS based on California Building Code is D.

4. Based upon field observations, laboratory testing and analysis, the alluvial deposits found in the exploratory borings should possess sufficient strength to support the proposed developments.

RECOMMENDATIONS

Specific

1. The proposed developments should be supported on foundations embedded into compacted fill.
2. To create a uniform building pad for the proposed developments, the existing fill and soil should be removed to competent alluvial materials and replaced as compacted fill. In addition, the proposed removals should extend a minimum of three feet below the proposed foundations.
3. The soils chemistry results should be incorporated into the design of the proposed project.
4. The property owner shall maintain the site as outlined in the Drainage and Maintenance Section.

Drainage and Maintenance

Maintenance of properties must be performed to minimize the chance of serious damage and/or instability to improvements. Most problems are associated with or triggered by water. Therefore, a comprehensive drainage system should be designed and incorporated into the final plans. In addition, pad areas should be maintained and planted in a way that will allow this drainage system to function as intended. The property owner shall be fully responsible for dampness or water accumulation caused by alteration in grading, irrigation or installation of improper drainage system, and failure to maintain drain systems. The following are specific drainage, maintenance, and landscaping recommendations. Reductions in these recommendations will reduce their effectiveness and may lead to damage and/or instability to

the improvements. It is the responsibility of the property owner to ensure that improvements, structures and drainage devices are maintained in accordance with the following recommendations and the requirements of all applicable government agencies.

Drainage

Positive pad drainage should be incorporated into the final plans. The pad should slope away from the footings at a minimum five percent slope for a horizontal distance of ten feet. In areas where there is insufficient space for the recommended ten foot horizontal distance concrete or other impermeable surface should be provided for a minimum of three feet adjacent the structure. Pad drainage should be at a minimum of two percent slope where water flow over lawn or other planted areas. Drainage swales should be provided with area drains about every fifteen feet. Area drains should be provided in the rear and side yards to collect drainage. All drainage from the pad should be directed so that water does not pond adjacent to the foundations or flow toward them. Roof gutters and downspouts are required for the proposed structures and should be connected into a buried area drain system. All drainage from the site should be collected and directed via non-erosive devices to a location approved by the building official. Area drains, subdrains, weep holes, roof gutters and downspouts should be inspected periodically to ensure that they are not clogged with debris or damaged. If they are clogged or damaged, they should be cleaned out or repaired.

Landscaping (Planting)

The property owner is advised not to develop planter areas between patios, sidewalk and structures. Planters placed immediately adjacent to the structures are not recommended. If planters are proposed immediately adjacent to structures, impervious above-grade or below-grade planter boxes with solid bottoms and drainage pipes away from the structure are suggested. All slopes should be maintained with a dense growth of plants, ground-covering vegetation, shrubs and trees that possess dense, deep root structures and require a minimum of irrigation. Plants surrounding the development should be of a variety that requires a minimum of watering. It is recommended that a landscape architect be consulted regarding planting adjacent to improvements. It will be the responsibility of the property owner to maintain the planting. Alterations of planting schemes should be reviewed by the landscape architect.

Irrigation

An adequate irrigation system is required to sustain landscaping. Over-watering resulting in runoff and/or ground saturation must be avoided. Irrigation systems must be adjusted to account for natural rainfall conditions. Any leaks or defective sprinklers must be repaired immediately. To mitigate erosion and saturation, automatic sprinkling systems must be adjusted for rainy seasons. A landscape architect should be consulted to determine the best times for landscape watering and the proper usage.

Pools/Plumbing

Leakage from a swimming pool or plumbing can produce a perched groundwater condition that may cause instability or damage to improvements. Therefore, all plumbing should be leak-free.

Grading and Earthwork

Proposed grading will consist of removal and recompaction and foundation excavations.

Remedial grading is recommended within the building areas in order to remove the existing fill, and upper portion of the alluvial soils. Based on the conditions encountered in the explorations the recommended removals are anticipated to depths of about 5 feet from the existing grade. The over-excavation should extend a minimum of five feet beyond the building perimeters, and to an extent equal to the depth of fill below the new foundations. If the proposed structure incorporates exterior columns (such as for an overhang) the over-excavation should also encompass these areas.

Following the completion of the over-excavation, the subgrade soils should be evaluated by the project geotechnical engineer to verify their suitability to support the structural fill as well as to support the foundation loads of the proposed development. This evaluation may include probing and proof-rolling to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if additional fill materials or dry, loose, porous or otherwise unsuitable materials are encountered at the base of the over-excavation.

Flatland Grading

1. Prior to commencement of work, a pre-grading meeting shall be held. Participants at this meeting will consist of the contractor, the owner or his representative, and the soils engineer. The purpose of the meeting is to avoid misunderstanding of the recommendations set forth in this report that might cause delays in the project.

2. Prior to placement of fill, all vegetation, rubbish, and other deleterious material should be disposed of offsite. The proposed structures should be staked out in the field by a surveyor. This staking should, as a minimum, include areas for overexcavation, toes of slopes, tops of cuts, setbacks, and easements. All staking shall be offset from the proposed grading area at least five feet (5'). Line and grade verification is not provided by GeoConcepts, Inc.

3. The natural ground, that is determined to be satisfactory for the support of the filled ground, shall then be scarified to a depth of at least six inches (6") and moistened as required. The scarified ground should be compacted to at least 90 percent of the maximum laboratory density (ASTM D 1557).

4. The fill soils shall consist of materials approved by the project Soils Engineer or his representative. These materials may be obtained from the excavation areas and any other approved sources, and by blending soils from one or more sources. The material used shall be free from organic vegetable matter and other deleterious substances, and shall not contain rocks greater than eight inches (8") in diameter nor of a quantity sufficient to make compaction difficult.

5. The approved fill material shall be placed in approximately level layers six inches (6") thick, and moistened as required. Each layer shall be thoroughly mixed to attain uniformity of moisture in each layer.

   When the moisture content of the fill is (3) percent or more below the optimum moisture content, as specified by the Soils Engineer, water shall be added and thoroughly mixed in until the moisture content is within (3) percent of the optimum moisture content.

   When the moisture content of the fill is (3) percent or more above the optimum moisture content as specified by the Soils Engineer, the fill material shall be aerated by scarifying or shall be blended with additional materials and thoroughly mixed until the moisture content is within (3) percent or less of the optimum moisture content.

   Each layer of fill material shall be compacted to a minimum of (90) percent of the maximum dry density as determined by ASTM D 1557, using approved compaction equipment. Where cohesionless soil having less than (15) percent finer than (0.005) millimeters is used for fill, the fill material shall be compacted to a minimum of (95) percent of the maximum dry density.

6. Review of the fill placement should be provided by the Soils Engineer or his representative during the progress of grading. In general, density tests (ASTM D 1556) and (*ASTM D 2922 & 3017*) will be made at intervals not exceeding two feet (2') of fill height or every 500 cubic yards of fill placed.

7. During the inclement part of the year, or during periods when rain is threatening, all fill that has been spread and awaits compaction shall be compacted before stopping work for the day or before stopping because of inclement weather. These fills, once compacted, shall have the surfaces sloped to drain to one area where water may be removed.

   Work may start again, after the rainy period, once the site has been reviewed by the Soils Engineer and he has given his authorization to resume. Loose materials not compacted prior to the rain shall be removed and aerated so that the moisture content of these fills will be within (3) percent of the optimum moisture content.

   Surface materials previously compacted before the rain, shall be scarified, brought to the proper moisture content, and re-compacted prior to placing additional fill, if deemed necessary by the Soils Engineer.

8. Review of geotechnical data available for the local vicinity of the site indicates that septic tanks, seepage pits, or leach fields may be encountered during site grading. If encountered, these should be drained of effluent or drilled out if they have been backfilled. The cleaned-out area should be inspected by the soils engineer and governing inspector prior to backfill. The pool may be filled with approved compacted fill, lean concrete, or gravel. Whichever backfill material is selected, at least five feet (5') of approved manmade fill, placed at 90 percent relative compaction should cap the pool.

Foundations

It is recommended that the proposed structure be founded into compacted fill.

The minimum continuous footing size is (12) inches wide and (24) inches deep into the compacted fill, measured from the lowest adjacent grade. Continuous footings may be proportioned, using a bearing value of (1500) pounds per square foot. Column footings placed into the compacted fill may be proportioned, using a bearing value of (2000) pounds per square foot, and should be a minimum of (2) feet in width and (24) inches deep, below the lowest adjacent grade.

All continuous footings shall be reinforced with a minimum of (4) #(5) bars, two placed near the top and two near the bottom. Reinforcing recommendations are minimums and may be revised by the structural engineer.

The bearing values given above are net bearing values; the weight of concrete below grade may be neglected. These bearing values may be increased by one-third (1/3) for temporary loads, such as, wind and seismic forces.

All footing excavation depths will be measured from the lowest adjacent grade of recommended bearing material. Footing depths will not be measured from any proposed elevations or grades. Any foundation excavations that are not the recommended depth into the recommended bearing materials will not be acceptable to this office.

Lateral loads may be resisted by friction at the base of the conventional foundations and by passive resistance within the compacted fill. A coefficient of friction of (0.4) may be used between the foundations and the compacted fill. The passive resistance may be assumed to act as a fluid with a density of (250) pounds per cubic foot.

Settlement

Settlement of the proposed structures will occur. Settlement of (1/8) to (1/4) inches between walls, within 20 feet or less, of each other, and under similar loading conditions, are considered normal. Total settlement on the order of (1/2) inches should be anticipated.

Expansive Soils

Expansive soils were not encountered on the subject property that are anticipated to adversely affect the proposed developments. Expansive soils can be a problem, as variation in moisture content will cause a volume change in the soil. Expansive soils heave when moisture is introduced and contract as they dry. During inclement weather and/or excessive landscape watering, moisture infiltrates the soil and causes the soil to heave (expansion). When drying occurs the soils will shrink (contraction).

Repeated cycles of expansion and contraction of soils can cause pavement, concrete slabs on grade and foundations to crack. This movement can also result in misalignment of doors and windows. To reduce the effect of expansive soils, foundation systems are usually deepened and/or provided with additional reinforcement design by the structural engineer. Planning of yard improvements should take into consideration maintaining uniform moisture conditions around structures. Soils should be kept moist, but water should not be allowed to pond. These designs are intended to reduce, but will not eliminate deflection and cracking and do not guarantee or warrant that cracking will not occur.

Excavations

Excavations ranging in vertical height up to five (5) feet will be required for the remedial grading. Conventional excavation equipment may be used to make these excavations. Excavations should expose competent alluvial materials. These soils are suitable for vertical excavations up to three feet, portions of the excavations above three feet should be trimmed back at a 1:1 (h:v). This should be verified by the project geotechnical engineer during construction so that modifications can be made if variations in the soil occur.

All excavations should be stabilized within 30 days of initial excavation. If this time is exceeded, the project geotechnical engineer must be notified, and modifications, such as shoring or slope trimming may be required. Water should not be allowed to pond on top of the excavation, nor to flow toward it. All excavations should be protected from inclement weather. This is required to keep the surface of the open excavation from becoming saturated during rainfall. Saturation of the excavation may result in a relaxation of the soils which may result in failures. Excavations should be kept moist, not saturated, to reduce the potential for raveling and sloughing during construction. No vehicular surcharge should be allowed within three feet (3') of the top of cut.

Excavations Maintenance – Erosion Control

The following recommendations should be considered a part of the excavation/erosion control plan for the subject site and are intended to supplement, but not supersede nor limit the erosion control plans produced by the Project Civil Engineer and/or Qualified SWPPP Developer. These recommendations should be implemented during periods required by the Building Code (typically between the months of October and April) or at any time of the year prior to a predicted rain event. Consideration should also be given to potential local sources of water/runoff such as existing drainage pipes or irrigation systems that remain in operation during construction activities.

Open Excavations:

All open excavations shall be protected from inclement weather, including areas above and at the toe of the excavation. This is required to keep the excavations from becoming saturated. Saturation of the excavation may result in a relaxation of the soils which may result in failures. Water/runoff should be diverted away from the excavation and not be allowed to flow over the excavation in a concentrated manner.

Hillside Excavations:

All hillside excavations shall be protected during inclement weather and should extend beyond the edges of the excavations in all directions. Plastic sheeting along with stakes, ropes and sandbags may be used to provide protection of the excavations. Water/runoff should be diverted away from the excavation and not be allowed to flow over the excavation.

The project Civil Engineer should provide a plan depicting the required limits of erosion control. Slopes around an open excavation should be trimmed to slope away from the open excavation so that water/runoff will not drain into the excavation. Any trees or planters that might cause failures around an open excavation shall be anchored safely. After the inclement weather has ceased, the excavations shall be reviewed by the project geotechnical engineer and geologist for safety prior to recommencement of work.

Open Trenches/Foundation Excavations:

No water should be allowed to pond adjacent to or flow into open trenches. All open trenches shall be covered with plastic sheeting that is anchored with sandbags. Areas around the trenches should be sloped away from the trenches to prevent water runoff from flowing into or ponding adjacent to the trenches.

After the inclement weather has ceased, the excavations shall be reviewed by the project geotechnical engineer and geologist for safety prior to recommencement of work. Foundation excavations that remain open during inclement weather shall be reviewed by the project geotechnical engineer and geologist prior to the placement of steel and concrete to ensure that proper embedment and contact with the bearing material have been maintained.

Open Pile/Caisson Excavations:

All pile/caisson excavations should be reviewed and poured prior to the onset of inclement weather. It is not recommended that any pile/caisson excavations remain open through any inclement weather. However, if it is necessary to leave pile/caisson excavations open during inclement weather, all water and runoff shall be diverted away from and prevented from entering the pile/caisson excavations. Pile/caisson excavations that remain open during inclement weather shall be reviewed by the project geotechnical engineer and geologist prior to the placement of steel and concrete to ensure that proper embedment has been maintained. The base of all end-bearing caissons shall be re-cleaned to ensure contact with the proper bearing material. All stockpiled cuttings from the pile borings shall be removed.

Grading In Progress:

During the inclement time of the year, or during periods prior to the onset of rain, all fill that has been spread and is awaiting compaction shall be compacted before stopping work for the day or before stopping work because of inclement weather. These fills, once compacted, shall have the surface sloped to drain to one area where water may be removed.

Additionally, it is suggested that all stock-piled fill materials be covered with plastic sheeting. This action will reduce the potential for the moisture content of the fill from becoming too high for compaction. If the fill stockpile is not covered during inclement weather, then aerating the fill to reduce the moisture content would be required. This action is generally very time consuming and may result in construction delays.

Work may recommence, after the rain event, once the site has been reviewed by the project geotechnical engineer.

Slabs on Grade

Slabs on grade should be reinforced with minimum #4 reinforcing bars, placed at (16) inches on center each way and supported on compacted fill. Provisions for cracks should be incorporated into the design and construction of the foundation system, slabs, and proposed floor coverings. Concrete slabs should have sufficient control joints spaced at a maximum of approximately 8 feet. Two-car garage slabs should be quartered or saw cut slabs and isolated from the stem wall footing to mitigate cracking. These recommendations are considered minimums unless superseded by the project structural engineer.

It is recommended that a vapor retarder/waterproofing be placed below the concrete slab on grade. Vapor/moisture transmission through slabs does occur and can impact various components of the structure. Waterproofing design and inspection of installation is not the responsibility of the geotechnical engineer. GeoConcepts, Inc. does not practice in the field of water and moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/firm be engaged/consulted to evaluate the general and specific water and moisture vapor transmission paths and any impact on the proposed development. This person/firm should provide recommendations for mitigation of potential adverse impact of water and moisture vapor transmission on various components of the structure as deemed necessary. The actual waterproofing design shall be provided by the architect, structural engineer or contractor with experience in waterproofing.

Decking

Exterior decking slabs on grade should be reinforced with minimum #4 reinforcing bars, placed at (16) inches on center each way and supported on compacted fill. Provisions for cracks should be incorporated into the design and construction of the decking. Concrete slabs should have sufficient control joints spaced at a maximum of approximately 8 feet. Decking planned adjacent to lawns, planters or adjacent to descending slopes should be provided with a 12-inch thickened edge. The deck reinforcement should be bent down into the edge. These recommendations are considered minimums unless superseded by the project structural engineer.

REVIEWS

Plan Review and Plan Notes

The final grading, building, and/or structural plans shall be reviewed and approved by the consultants to ensure that all recommendations are incorporated into the design or shown as notes on the plan.

The final plans should reflect the following:

1. The Preliminary Geotechnical Engineering Investigation by GeoConcepts, Inc. is a part of the plans.
2. Plans must be reviewed and signed by GeoConcepts, Inc.
3. The project geotechnical engineer must review all grading.
4. The project geotechnical engineer shall review all foundations.

Construction Review

Reviews will be required to verify all geotechnical work. It is required that all footing excavations, seepage pits, and grading be reviewed by this office. This office should be notified at least **two working days** in advance of any field reviews so that staff personnel may be made available.

The property owner should take an active role in project safety by assigning responsibility and authority to individuals qualified in appropriate construction safety principles and practices. Generally, site safety should be assigned to the general contractor or construction manager that is in control of the site and has the required expertise, which includes but not limited to construction means, methods and safety precautions.

LIMITATIONS

General

This report is intended to be used only in its entirety. No portion or section of the report, by itself, is designed to completely represent any aspect of the project described herein. If any reader requires additional information or has questions regarding this report, GeoConcepts, Inc. should be contacted.

Subsurface conditions were interpreted on the basis of our field explorations and past experience. Although, between exploratory excavations, subsurface earth materials may vary in type, strength and many other properties from those interpreted. The findings, conclusions and recommendations presented herein are for the soil conditions encountered in the specific locations. Earth materials and conditions immediately adjacent to, or beneath those observed

may have different characteristics, such as, earth type, physical properties and strength. Other soil conditions due to non-uniformity of the soil conditions or manmade alterations may be revealed during construction. If subsurface conditions differ from those encountered in the described exploration, this office should be advised immediately so that further recommendations may be made if required. If it is desired to minimize the possibility of such changes, additional explorations and testing can/should be performed.

Findings, conclusions and recommendations presented herein are based on experience and background. Therefore, findings, conclusions and recommendations are professional opinions and are not meant to indicate a control of nature.

This preliminary report provides information regarding the findings on the subject property. It is not designed to provide a guarantee that the site will be free of hazards in the future, such as but not limited to, landslides, slippage, liquefaction, expansive soils, differential settlement, debris flows, seepage, concentrated drainage or flooding. It may not be possible to eliminate all hazards, but homeowners must maintain their property and improve deficiencies to minimize these hazards.

This report may not be copied. If you wish to purchase additional copies, you may order them from this office.

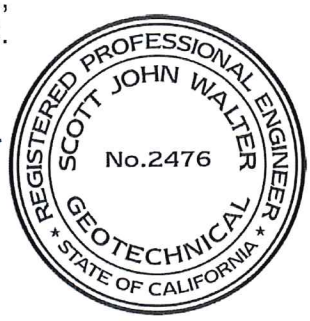
CONSTRUCTION NOTICE

Construction can be challenging. GeoConcepts, Inc. has provided this report to advise you of the general site conditions, geotechnical feasibility of the proposed project, and overall site stability. It must be understood that the professional opinions provided herein are based upon subsurface data, laboratory testing, analyses, and interpretation thereof. Recommendations contained herein are based upon surface reconnaissance and minimum subsurface explorations deemed suitable by your consultants.

Although quantities for foundation concrete and steel may be estimated based on the findings provided in this report, provision should be made for possible changes in quantities during construction. If it is desired to minimize the possibility of such changes, additional exploration and testing should be considered. However, you must be aware that depths and magnitudes will most likely vary between explorations given in the report.

We appreciate the opportunity of serving you on this project. If you have any questions concerning this report, please contact the undersigned.

Respectfully submitted,
GEOCONCEPTS, INC.



Scott J. Walter
Project Engineer
GE 2476
SJW/RD: 5071-1

Distribution: (4) Addressee

APPENDIX I

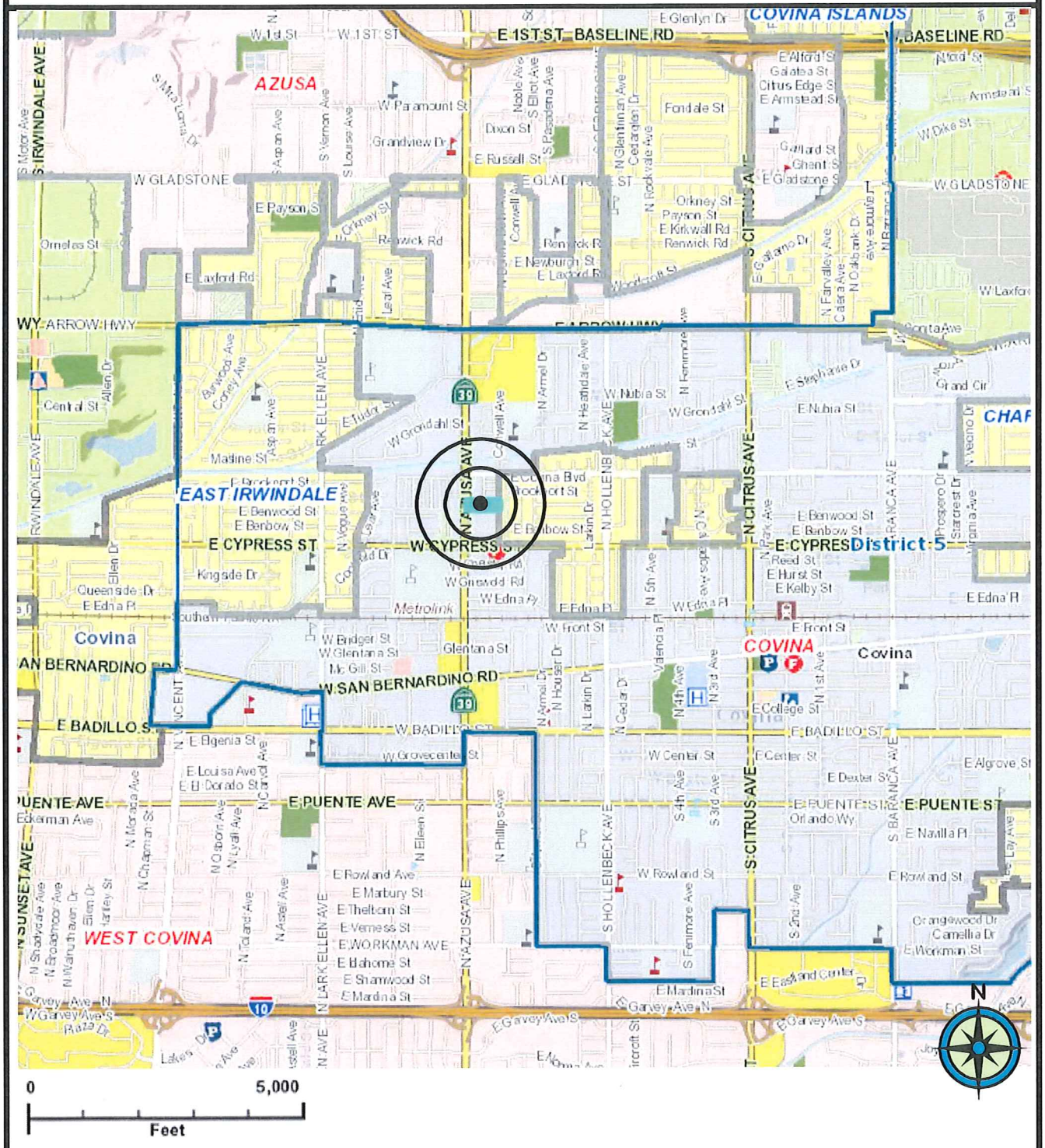
SITE INFORMATION

Location Map
Groundwater Map
USGS Fault Map
Seismic Hazard Map

Plot Map

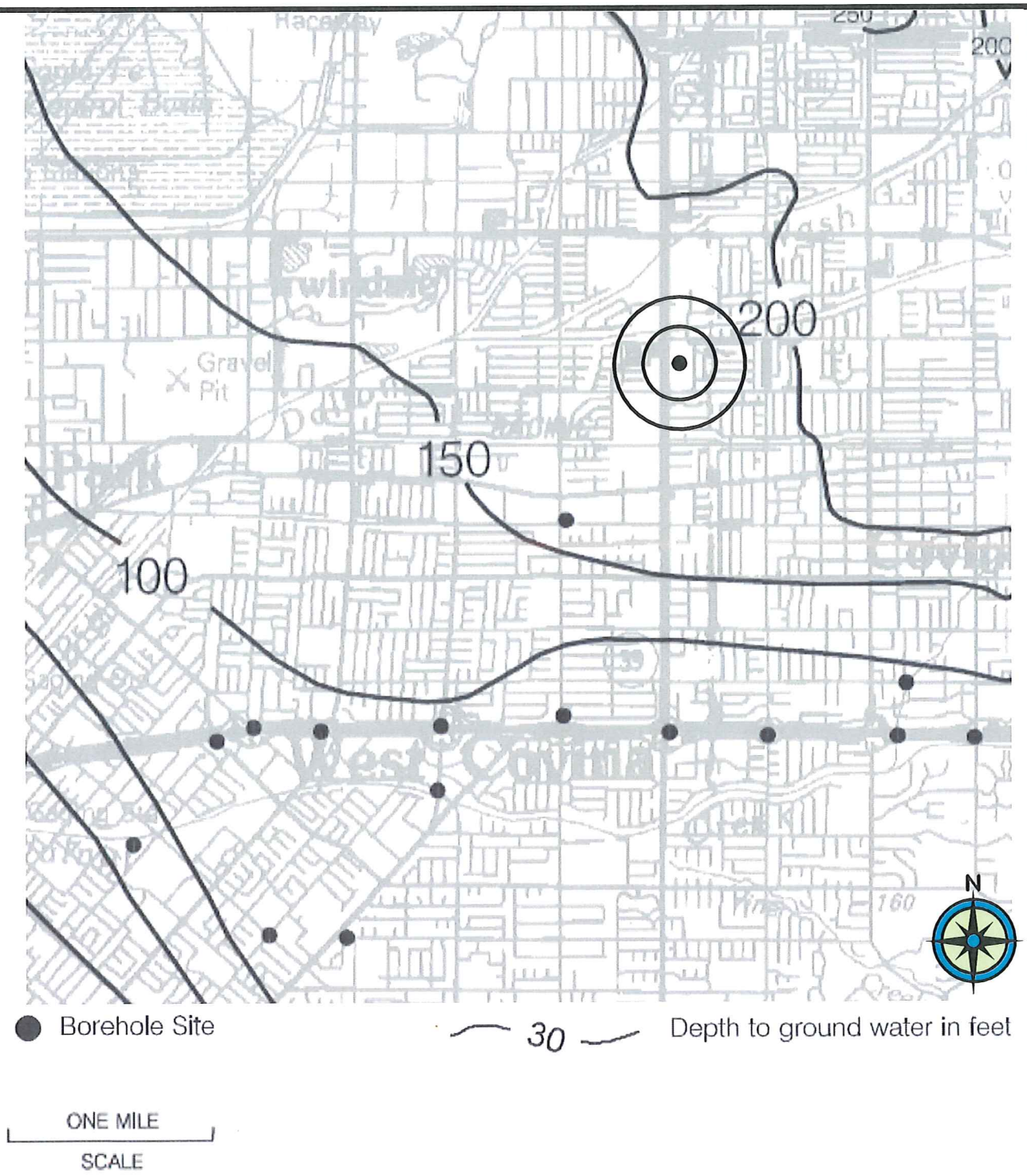
Field Exploration
Borings 1 through 5

LOCATION MAP



Reference:	County of Los Angeles, Department of Regional Planning, GIS-NET3	Scale: As Shown

GROUNDWATER MAP



Reference:	State of California Seismic Hazard Report, Baldwin Park Quadrangle	Scale: As Shown

USGS FAULT MAP

Lisa Wald, U.S. Geologic Survey (modified from SCEC).

1 Alamo thrust
2 Arrowhead fault
3 Bailey fault
4 Big Mountain fault
5 Big Pine fault
6 Blake Ranch fault
7 Cabrillo fault
8 Chatsworth fault
9 Chino fault
10 Clamshell-Sawpit fault
11 Clearwater fault
12 Cleghorn fault
13 Crafton Hills fault zone
14 Cucamonga fault zone
15 Dry Creek
16 Eagle Rock fault
17 El Modeno
18 Frazier Mountain thrust
19 Garlock fault zone
20 Grass Valley fault
21 Helendale fault
22 Hollywood fault
23 Holser fault
24 Lion Canyon fault
25 Llano fault
26 Los Alamitos fault
27 Malibu Coast fault
28 Mint Canyon fault
29 Mirage Valley fault zone
30 Mission Hills fault
31 Newport Inglewood fault zone
32 North Frontal fault zone
33 Northridge Hills fault
34 Oak Ridge fault
35 Palos Verdes fault zone
36 Pelona fault
37 Peralta Hills fault
38 Pine Mountain fault
39 Raymond fault
40 Red Hill (Etiwanda Ave) fault
41 Redondo Canyon fault
42 San Andreas Fault
43 San Antonio fault
44 San Cayetano fault
45 San Fernando fault zone
46 San Gabriel fault zone
47 San Jacinto fault
48 San Jose fault
49 Santa Cruz-Santa Catalina Ridge f.z.
50 Santa Monica fault
51 Santa Ynez fault
52 Santa Susana fault zone
53 Sierra Madre fault zone
54 Simi fault
55 Soledad Canyon fault
56 Stoddard Canyon fault
57 Tunnel Ridge fault
58 Verdugo fault
59 Waterman Canyon fault
60 Whittier fault

Reference:	U. S. G. S: active fault (red) and potentially active fault (green)	

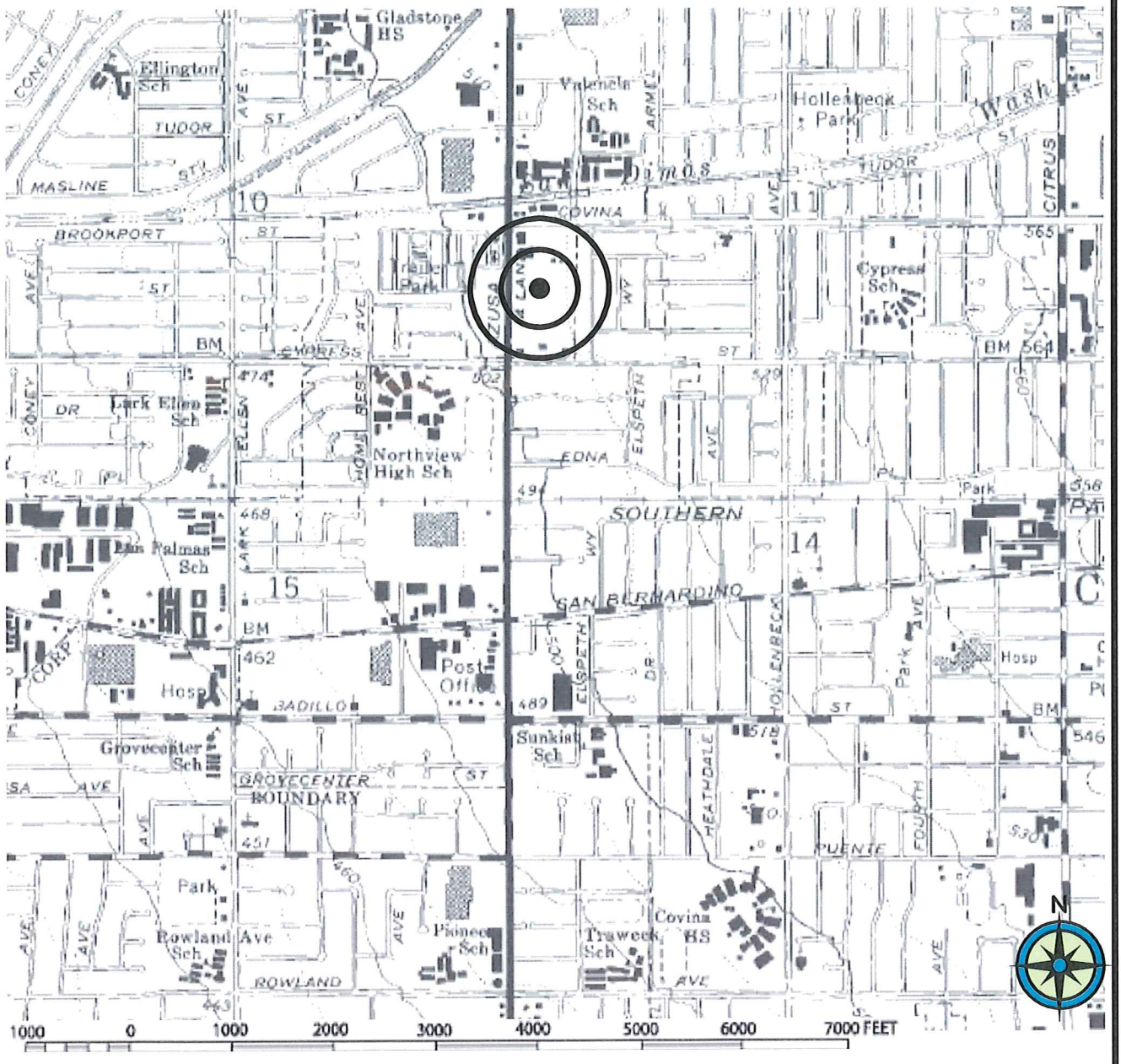
SEISMIC HAZARD MAP

Earthquake-Induced Landslides

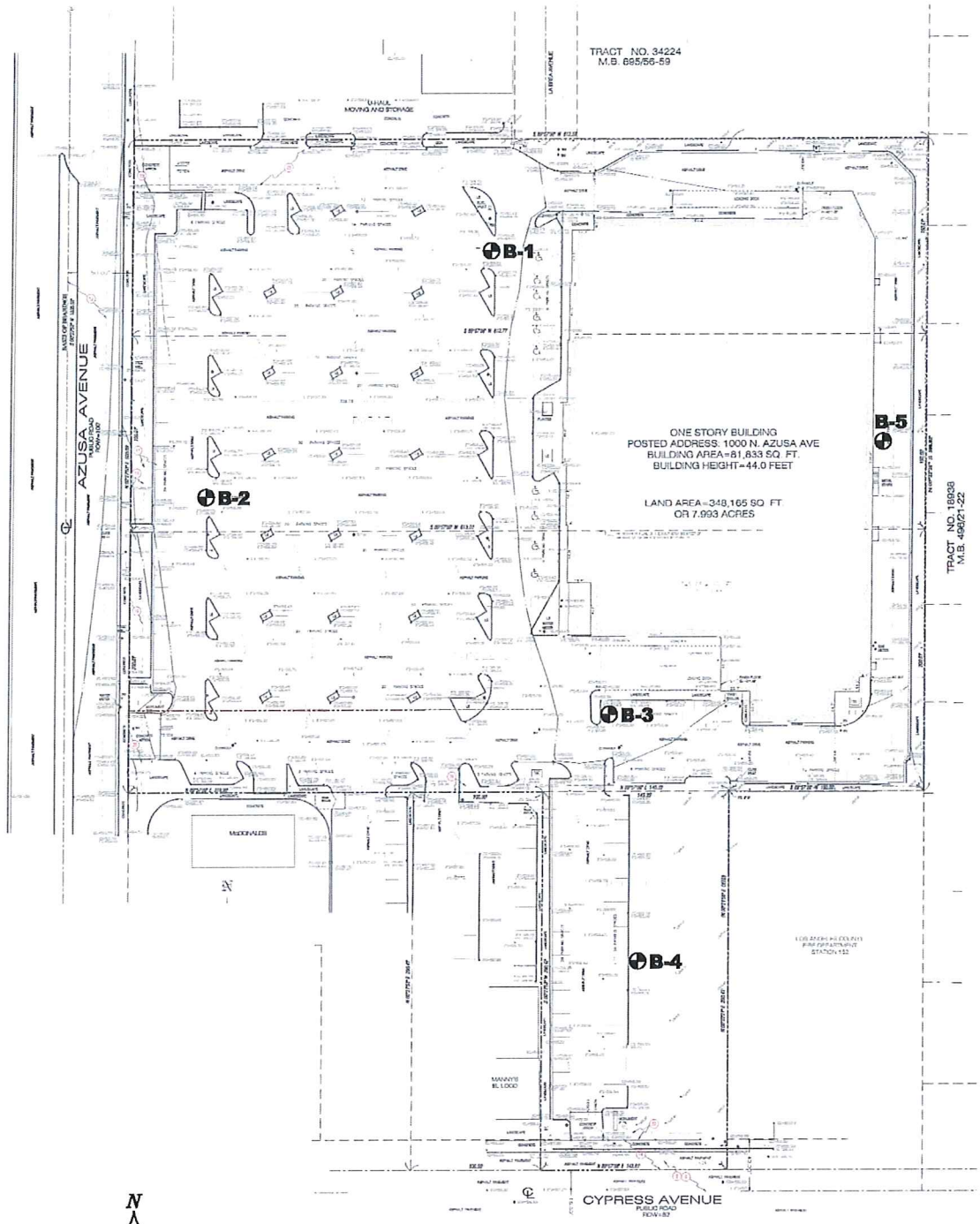
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.



Reference:	State of California, Seismic Hazard Map of the Baldwin Park Quadrangle	Scale: As Shown



Explanation	
B-5 ⊕	Location of Borings

GeoConcepts INC
Geology - Geotechnical Engineering
14428 Hamlin Street, Suite 200, Van Nuys, CA 91401
Ph (818) 994-8895 | Fax (818) 994-8599 | www.GeoConceptsInc.com

Description:	Plot Map
Base Map Provided By:	Delta Surveying & Mapping
Project Address:	1000 North Azusa Avenue Covina, California
Date:	Dec. 2015
Scale:	1" = 80'
Job No.	5071-1

BORING: B-1

ADDRESS: 1000 North Azusa Avenue

PROJECT NO.: 5071

DATE LOGGED: November 6, 2015

LOGGED BY: RD

ATTITUDES (b - bedding, j - joint, s - shear, f - fault)	WATER CONTENT, %	UNIT DRY WEIGHT, PCF	BLOWS/FOOT	SAMPLES	DEPTH, FT	GRAPHIC LOG	DESCRIPTION
							0.0' - 2.0" **ASPHALT**
							ARTIFICIAL FILL; Af, silty sand with clay binder, medium reddish brown, slightly moist, fine to medium grained, glass and rock fragments up to 0.5" in length
							1.5' - 31.0' **ALLUVIUM; Qal,**
	5	116	69		5		@5.0' sand with silt and clay binder, medium brown, slightly moist, fine to coarse grained, ~3% coarse grained
	4	113	38		10		@10.0' silty sand, reddish brown, slightly moist, fine to medium grained, ~5% fine gravels
	2	115	33		15		@15.0' silty sand with gravels, tan to light brown, slightly moist, fine to medium grained sand, ~15% fine gravels
	3	112	50		20		@20.0' silty sand with gravels, light brown, slightly moist, fine to medium grained sand, ~15% fine gravels, 50 blows for 6 inches
			35		25		@25.0' silty sand with gravels, light brown, slightly moist, fine to medium grained sand, ~15% fine gravels
	4	121	50		30		@30.0' silty sand with gravels, light brown, slightly moist, fine to medium grained sand, ~15% fine gravels, 50 blows for 3 inches
							Total Depth - 31.0 Feet No Groundwater 8 Inch Hollow Stem Auger with Autohammer

BORING: B-2

ADDRESS: 1000 North Azusa Avenue

PROJECT NO.: 5071

DATE LOGGED: November 6, 2015

LOGGED BY: RD

ATTITUDES
b - bedding j - joint
s - shear f - fault

WATER CONTENT, %	UNIT DRY WEIGHT, PCF	BLOWS/FOOT	SAMPLES	DEPTH, FT	GRAPHIC LOG	DESCRIPTION
						0.0' - 2.0" **ASPHALT**
						ARTIFICIAL FILL; Af, silty sand with clay binder, medium reddish brown, slightly moist, fine to medium grained, glass and rock fragments up to 0.5" in length
4	114	41				1.5' - 31.0' **ALLUVIUM; Qal,**
				5		@2.5' silty sand to sandy silt, olive brown, slightly moist, fine to medium grained
3	106	30				@7.5' sand with silt, reddish brown, slightly moist, fine to medium grained
				10		
5	109	26				@12.5' sand with silt, tan to light brown, slightly moist, fine to coarse grained
				15		
1	116	42				@17.5' sand with silt, light reddish brown, slightly moist, fine to coarse grained with ~5% coarse grains, ~15% fine gravels
				20		
1	116	62				@22.5' sand with silt, light reddish brown, slightly moist, fine to coarse grained with ~5% coarse grains, ~10% fine gravels
				25		
2	118	50				@27.5' sand with minor silt, reddish brown, slightly moist to moist, fine to medium grained, ~15% fine to medium grained gravels, 50 blows for 4 inches
				30		
2	118	50				@30.0' sand with minor silt, reddish brown, slightly moist to moist, fine to medium grained, ~15% fine to medium grained gravels, 50 blows for 3 inches
						Total Depth - 31.0 Feet No Groundwater 8 Inch Hollow Stem Auger with Autohammer

BORING: B-3

ADDRESS: 1000 North Azusa Avenue

PROJECT NO.: 5071

DATE LOGGED: November 6, 2015

LOGGED BY: RD

ATTITUDES b - bedding j - joint s - shear f - fault	WATER CONTENT, %	UNIT DRY WEIGHT, PCF	BLOWS/FOOT	SAMPLES	DEPTH, FT	GRAPHIC LOG	DESCRIPTION
							0.0' - 28.5' **ALLUVIUM; Qal,**
	7	121	50		5		@2.5' silty sand, medium brown, slightly moist, fine grained, 50 blows for 6 inches
	4	110	28		10		@7.5' silty sand to sandy silt, medium brown, slightly moist, fine grained
	5	113	25		15		@12.5' sandy silt, medium brown, slightly moist, fine grained
	0	120	37		20		@17.5' sand with silt, white to tan, slightly moist, fine to coarse grained sand, ~15% fine to medium sized gravels
	2	123	50		25		@22.5' gravelly sand, reddish brown, slightly moist, fine to coarse grained sand, ~25% fine to medium sized gravels, 50 blows for 3 inches
	3	121	48		30		@27.5' gravelly sand, reddish brown, slightly moist, fine to coarse grained sand, ~25% fine to medium sized gravels
							Total Depth - 28.5 Feet No Groundwater 8 Inch Hollow Stem Auger with Autohammer

BORING: B-4

ADDRESS: 1000 North Azusa Avenue

PROJECT NO.: 5071

DATE LOGGED: November 6, 2015

LOGGED BY: RD

ATTITUDES b - bedding j - joint s - shear f - fault	WATER CONTENT, %	UNIT DRY WEIGHT, PCF	BLOWS/FOOT	SAMPLES	DEPTH, FT	GRAPHIC LOG	DESCRIPTION
							0.0' - 31.0' **ALLUVIUM; Qal,**
	6	106	32		5		@5.0' silty sand, medium brown, slightly moist, fine to medium grained
	9	105	29		10		@10.0' silty sand to sandy silt, reddish brown, slightly moist to moist, fine grained
	7	111	33		15		@15.0' silty sand to sandy silt, reddish brown, slightly moist to moist, fine grained
			50		20		@20.0' No Recovery
	9	112	48		25		@25.0' silty sand to sandy silt, yellowish brown, slightly moist, fine to medium grained
	6	115	49		30		@30.0' silty sand to sandy silt, yellowish brown, slightly moist, fine to medium grained
							Total Depth - 31.0 Feet No Groundwater 8" Hollow Stem Auger with Autohammer

BORING: B-5

ADDRESS: 1000 North Azusa Avenue

PROJECT NO.: 5071

DATE LOGGED: November 6, 2015

LOGGED BY: RD

ATTITUDES (b - bedding, j - joint, s - shear, f - fault)	WATER CONTENT, %	UNIT DRY WEIGHT, PCF	BLOWS/FOOT	SAMPLES	DEPTH, FT	GRAPHIC LOG	DESCRIPTION
							0.0' - 2.0" **ASPHALT**
							2.0" - 31.0' **ALLUVIUM; Qal,**
	3	109	27		5		@5.0' silty sand to sandy silt, light reddish brown, slightly moist, fine to medium grained
	3	107	22		10		@10.0' silty sand, light reddish brown, slightly moist, fine to medium grained
			26		15		@15.0' No Recovery
	3	113	50		20		@20.0' gravelly silty sand, light reddish brown, slightly moist, fine to medium grained sand, ~25% fine to coarse sized gravels, 50 blows for 5 inches
	5	112	45		25		@25.0' silty sand to sandy silt, light reddish brown, slightly moist to moist, fine to medium grained
	5	112	82		30		@30.0' sandy silt, reddish brown, slightly moist to moist, fine grained
							Total Depth - 31 Feet No Groundwater 8" Hollow Stem Auger with Autohammer

APPENDIX II

LABORATORY TESTING

Laboratory Procedures

Laboratory Recapitulation 1
Laboratory Recapitulation 2

Figures S.1 through S.5
Figures C.1 through C.6

LABORATORY PROCEDURES

Laboratory testing was performed on samples obtained as outlined in the Field Exploration section of this report. All samples were sent to the laboratory for examination, testing in general conformance to specified test methods, and classification, using the Unified Soil Classification System and group symbol.

Moisture and Density Tests

The dry unit weight and moisture content of the undisturbed samples were determined. The results are tabulated in the Laboratory Recapitulation - Table 1.

Shear Tests

Direct single-shear tests were performed with a direct shear machine. The desired normal load is applied to the specimen and allowed to come to equilibrium. The rate of deflection on the sample is approximately 0.005 inches per minute. The samples are tested at higher and/or lower normal loads in order to determine the angle of internal friction and the cohesion. The results are plotted on the Shear Test Diagrams and the results tabulated in the Laboratory Recapitulation - Table 1. The samples were observed prior to and after shearing to ensure the particle size of the sample did not exceed 10% of the diameter of the test specimen in accordance with ASTM standards. Although the soil was described to include gravels they were not included within the samples tested, therefore, the results provide a conservative estimate of the shear strength of the soil.

Consolidation

Consolidation tests were performed on samples, within the brass ring, to predict the soils behavior under a specific load. Porous stones are placed in contact with top and bottom of the samples to permit to allow the addition or release of water. Loads are applied in several increments and the results are recorded at selected time intervals. Samples are tested at field and increased moisture content. The results are plotted on the Consolidation Test Curve and the load at which the water is added as noted on the drawing.

pH (CTM 532)

A sample of dry soil and distilled water are placed in a flask and allowed to stand for approximately an hour to stabilize. The pH is measured using a pH meter that has been compensated for temperature. The results are tabulated in the Laboratory Recapitulation - Table 2.

Minimum Resistivity (CTM 532)

The electrical resistivity of each soil specimen is conducted in a two-stage process using the soil box method. The first stage measures the resistivity of the soil in its as-received condition and the second stage records the value after saturation with distilled water. The results are tabulated in the Laboratory Recapitulation - Table 2.

Chloride Content (CTM 422)

A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot of the sample is mixed with chloride indicator and titrated over silver nitrate solution. The chloride content is determined by the difference of the volumes required to complete titration. The results are tabulated in the Laboratory Recapitulation - Table 2.

Sulfate Content (CTM 417)

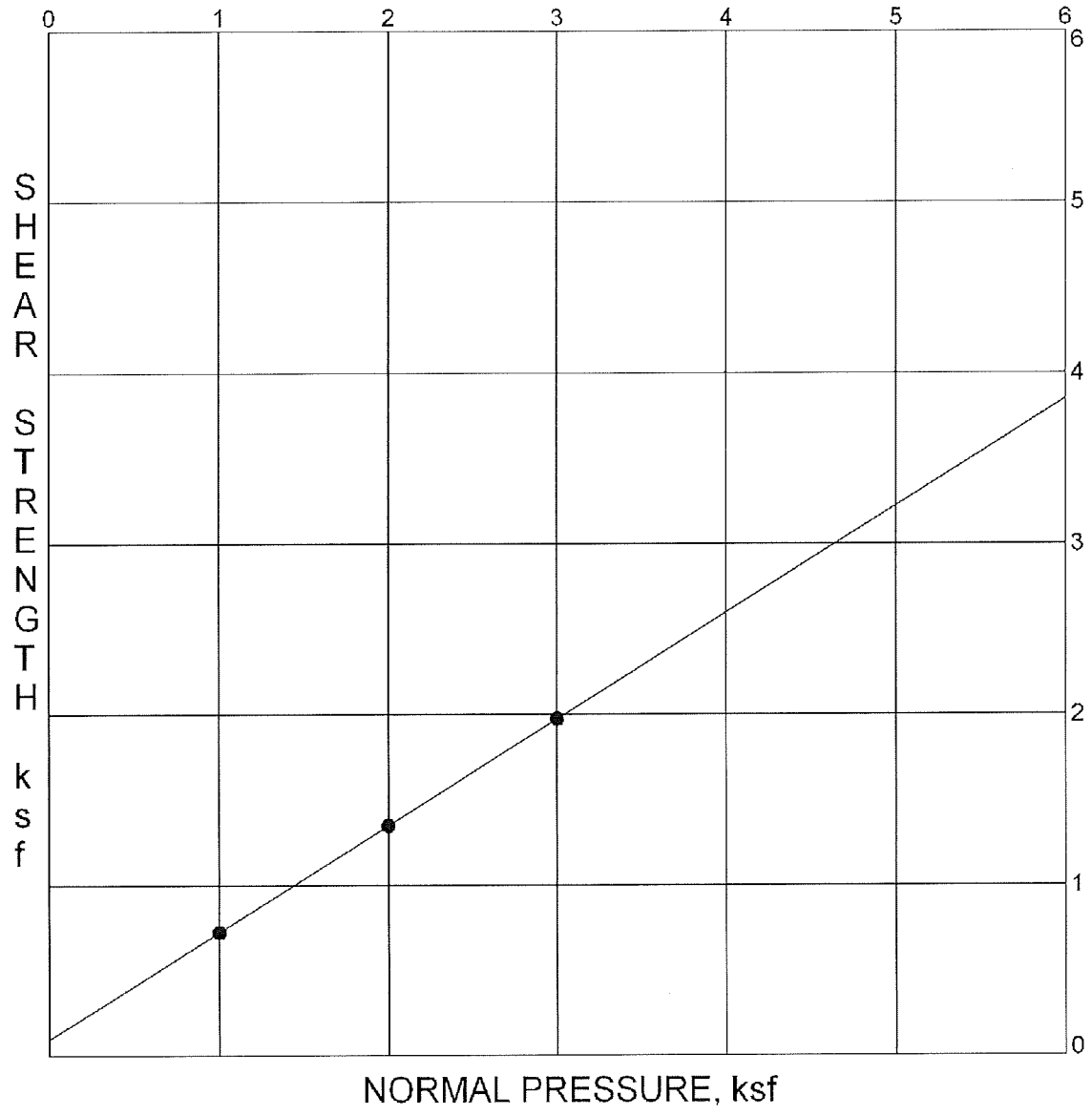
A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot is mixed with distilled water and a conditioning agent. The solution is then placed in a photometer and the value recorded. The process is repeated with the addition of barium chloride. The sulfate content is determined by the difference of the photometer readings. The results are tabulated in the Laboratory Recapitulation - Table 2.

LABORATORY RECAPITULATION 1 PROJECT: 1000 North Azusa Avenue PROJECT NO.: 5071						
Exploration	**Depth (ft)**	**Material**	**Dry Density In Situ (P.C.F.)**	**Moisture Content (%)**	**Cohesion (K.S.F)**	**Friction Angle (degree)**
B-1	5	Qal	116.1	5.1	0.1	32
B-1	10	Qal	113	4.4		
B-1	15	Qal	115	1.9		
B-1	20	Qal	112.1	2.5		
B-1	25	Qal				
B-1	30	Qal	121	3.8		
B-2	2.5	Qal	114	4.4		
B-2	7.5	Qal	105.7	3.2		
B-2	12.5	Qal	109.5	4.9		
B-2	17.5	Qal	116.1	1.1		
B-2	22.5	Qal	116.1	1		
B-2	27.5	Qal	118.4	1.6		
B-2	30	Qal	117.6	1.5		
B-3	2.5	Qal	121.2	6.9	0.05	32
B-3	7.5	Qal	109.7	4.1	0.05	30
B-3	12.5	Qal	113.3	5.2		
B-3	17.5	Qal	120.5	0.5		
B-3	22.5	Qal	123.1	1.9		
B-3	27.5	Qal	120.5	2.7		
B-4	5	Qal	106	6.2		
B-4	10	Qal	105	9		
B-4	15	Qal	111.1	7		
B-4	25	Qal	112	9.5		
B-4	30	Qal	115	5.9		
B-5	5	Qal	109	3.2	0.15	27
B-5	10	Qal	107.2	2.7	0.05	30
B-5	20	Qal	113.5	3.2		
B-5	25	Qal	112	5.1		
B-5	30	Qal	112.2	4.9		

LABORATORY RECAPITULATION 2 PROJECT: 1000 North Azusa Avenue PROJECT NO.: 5071						
Exploration	**Depth (ft)**	**pH**	**As-Is Soil Resistivity (ohm-cm)**	**Minimum Soil Resistivity (ohm-cm)**	**Chloride (%)**	**Sulphate (%)**
B-3	12.5	7.11	29000	6000	0.001	0.00042

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-1 @ 5.0 DESCRIPTION: Qal



Test Results

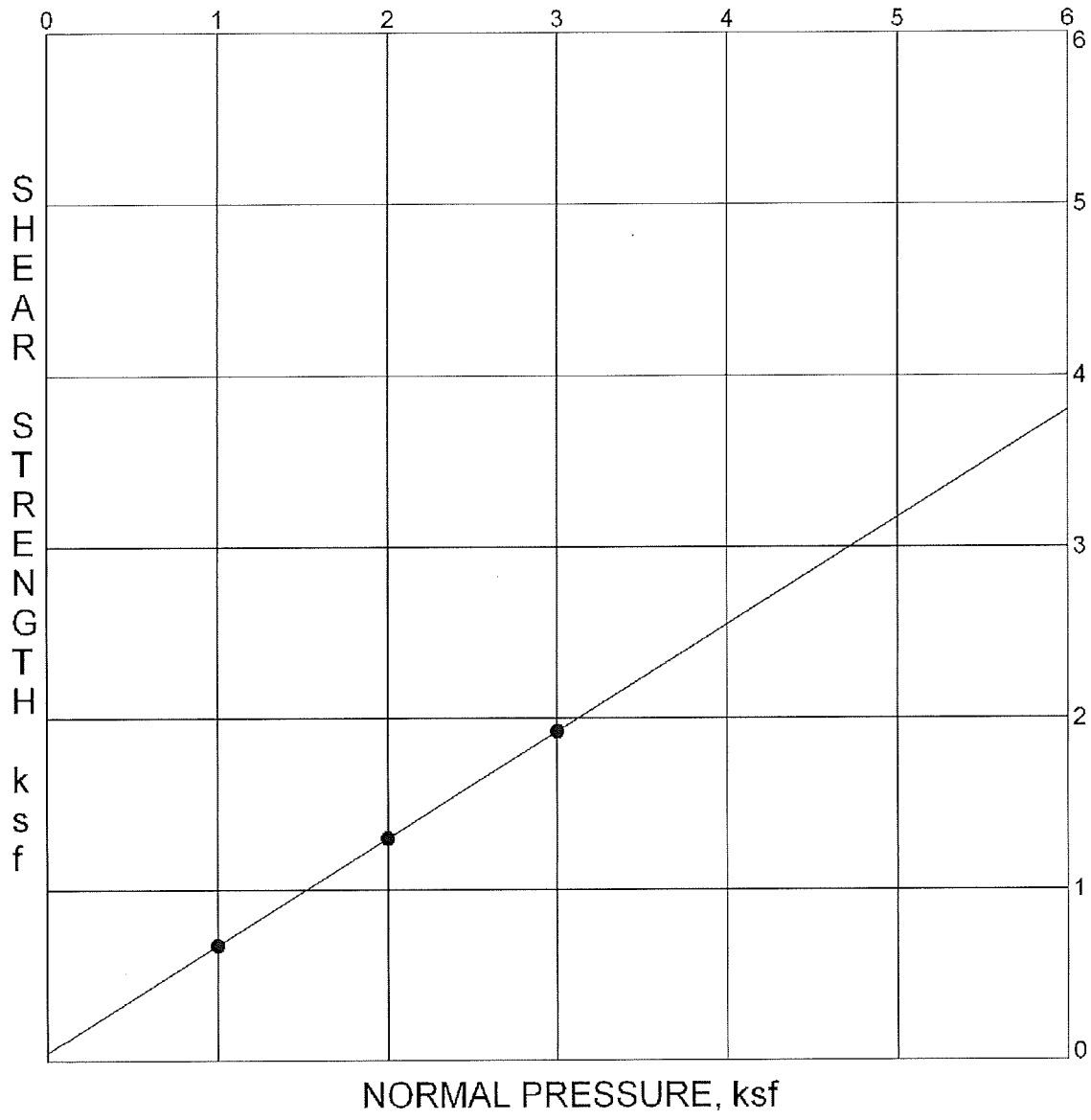
Moisture Content (%)	Density (pcf)	Ultimate Strength
Insitu: 5.1	Dry Density: 116.1	Phi (deg): 32.0
Saturated: 16.7		Cohesion (ksf): 0.100

SHEAR TEST DIAGRAM

Figure S.1

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-3 @ 2.5 DESCRIPTION: Qal



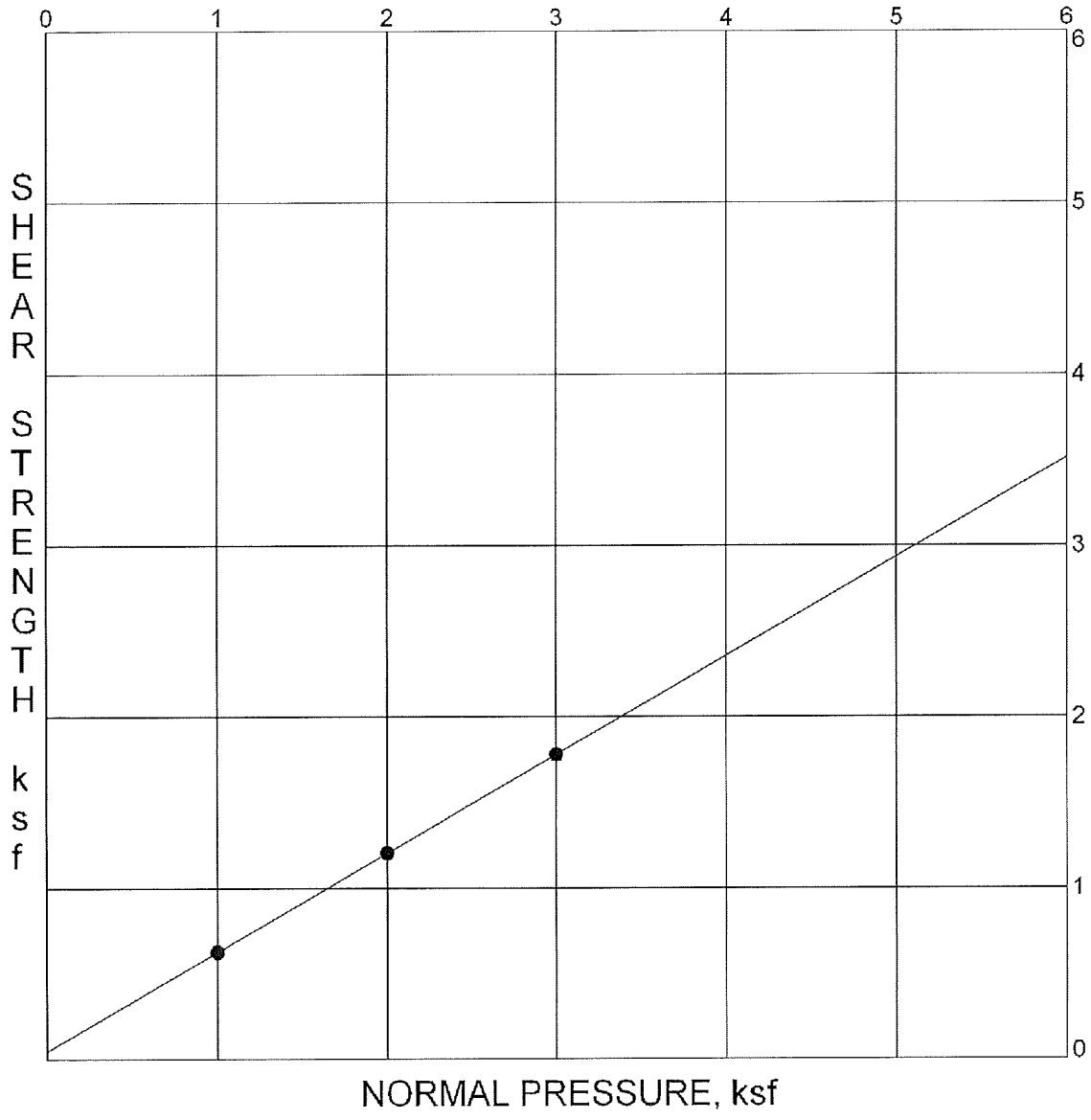
Test Results

Moisture Content (%)	Density (pcf)	Ultimate Strength
Insitu: 6.9	Dry Density: 121.2	Phi (deg): 32.0
Saturated: 14.5		Cohesion (ksf): 0.050

SHEAR TEST DIAGRAM Figure S.2

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-3 @ 7.5 DESCRIPTION: Qal



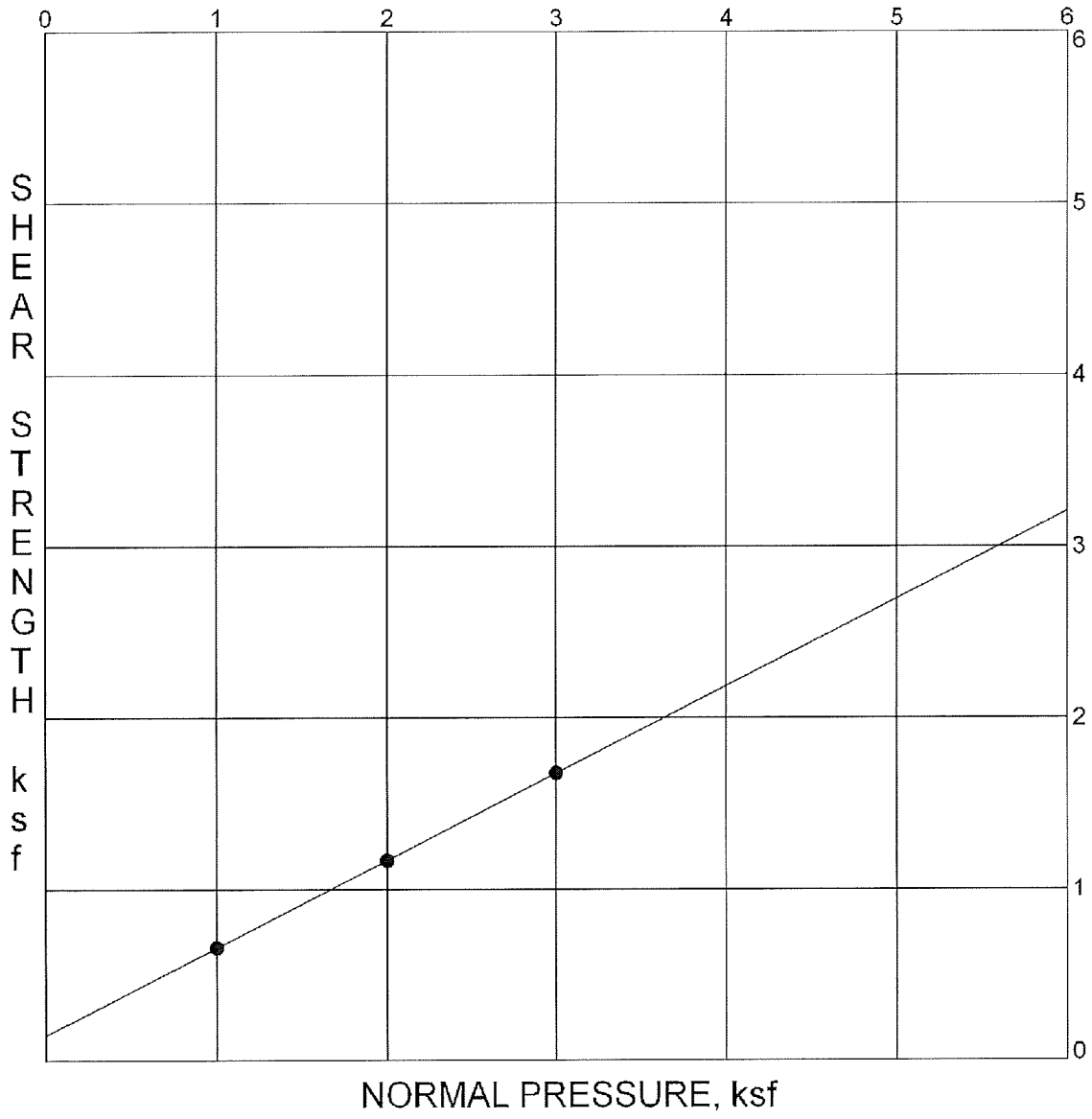
Test Results

Moisture Content (%)	Density (pcf)	Ultimate Strength
Insitu: 4.1	Dry Density: 109.7	Phi (deg): 30.0
Saturated: 19.9		Cohesion (ksf): 0.050

SHEAR TEST DIAGRAM Figure S.3

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-5 @ 5.0 DESCRIPTION: Qal



Test Results

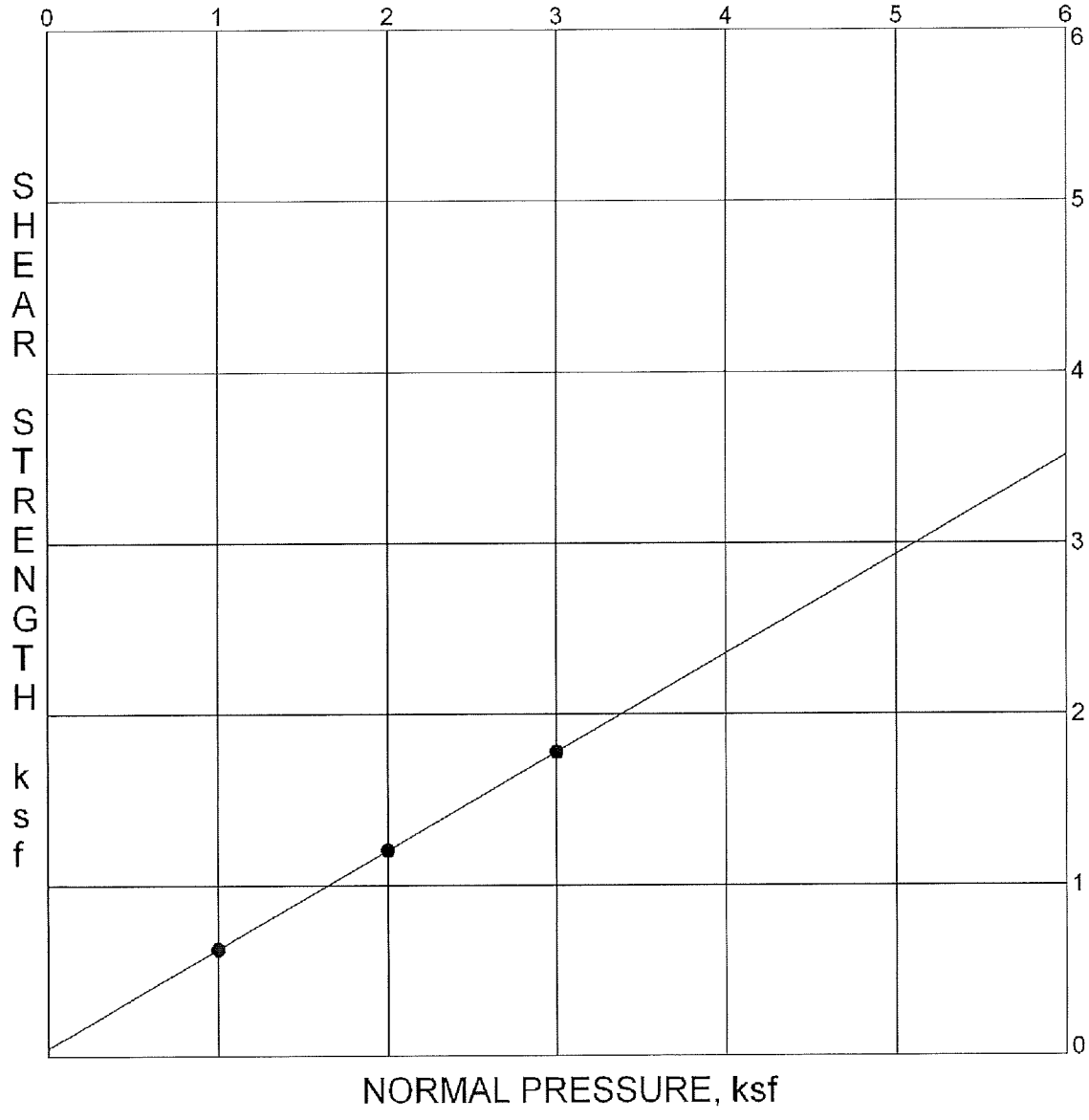
Moisture Content (%)	Density (pcf)	Ultimate Strength
Insitu: 3.2	Dry Density: 109.0	Phi (deg): 27.0
Saturated: 20.2		Cohesion (ksf): 0.150

SHEAR TEST DIAGRAM

Figure S.4

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-5 @ 10.0 DESCRIPTION: Qal



Test Results

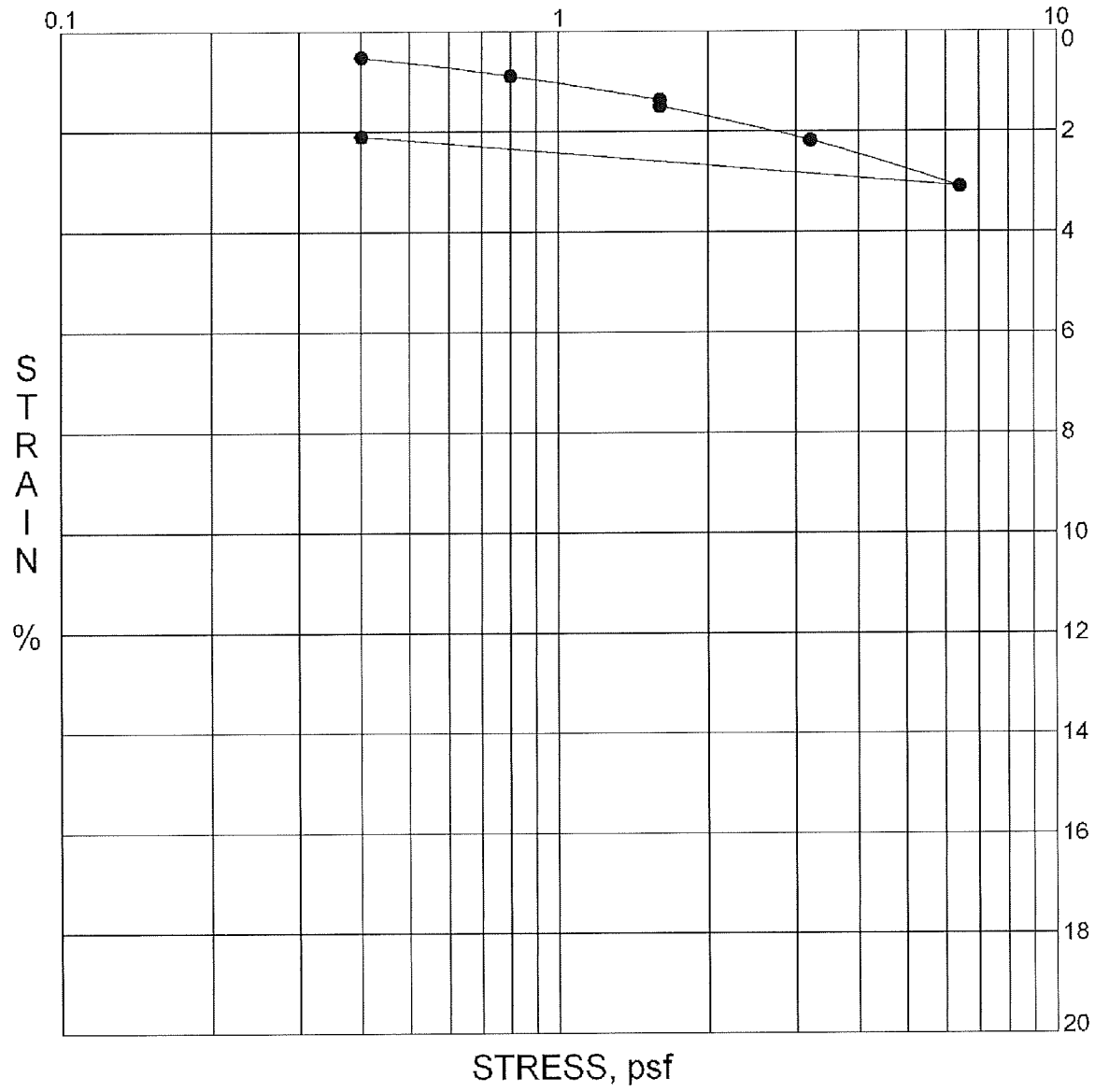
Moisture Content (%)	Density (pcf)	Ultimate Strength
Insitu: 2.7	Dry Density: 107.2	Phi (deg): 30.0
Saturated: 21.1		Cohesion (ksf): 0.050

SHEAR TEST DIAGRAM

Figure S.5

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-1 @ 5.0 DESCRIPTION: Qal



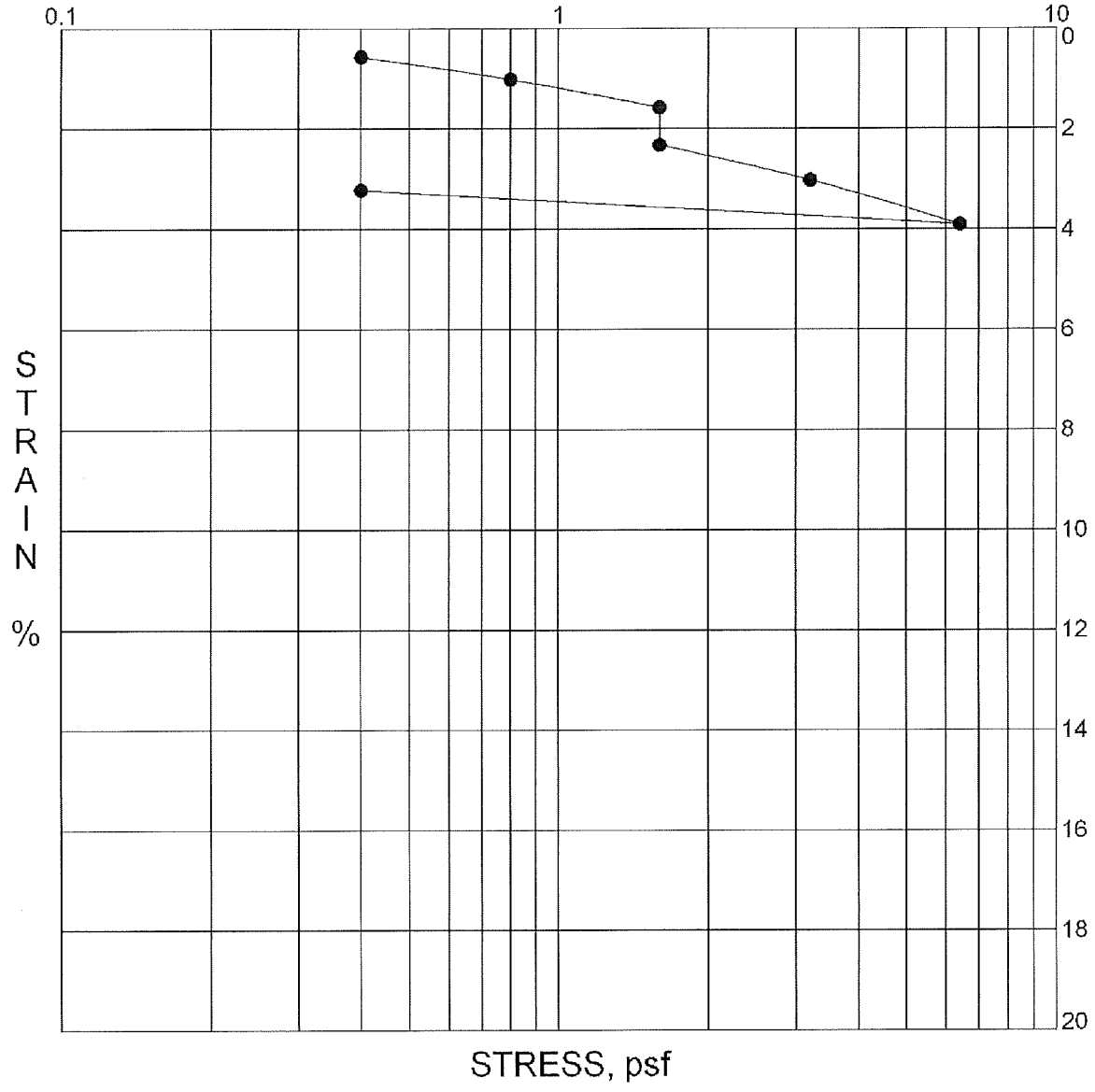
Test Results

Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 5.1	Dry Density: 116.1	**1600 lbs.**

CONSOLIDATION TEST DIAGRAM Figure C.1

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-2 @ 7.5 DESCRIPTION: Qal



Test Results

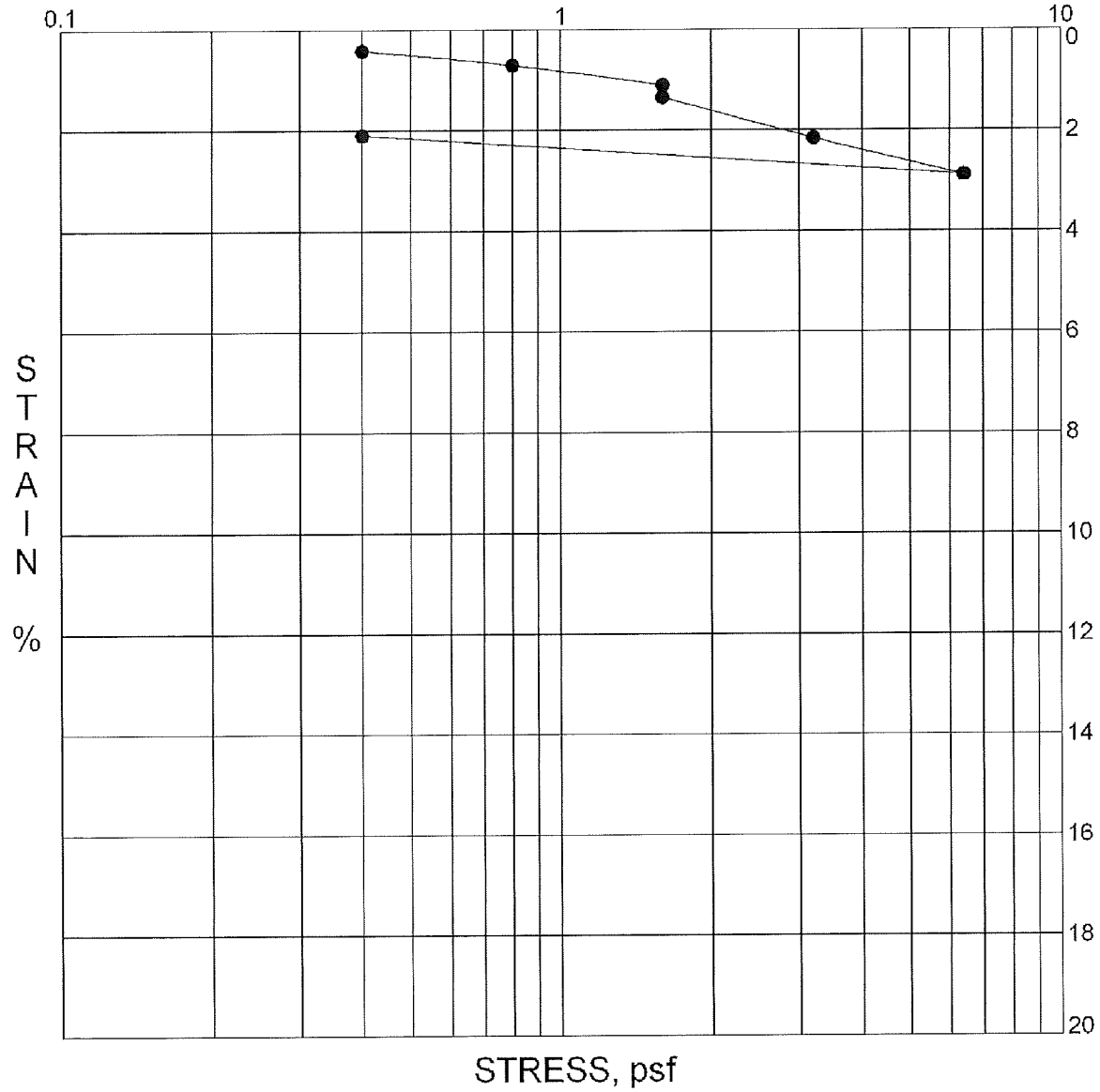
Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 3.2	Dry Density: 105.7	1600 lbs.

CONSOLIDATION TEST DIAGRAM

Figure C.2

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-3 @ 2.5 DESCRIPTION: Qal



Test Results

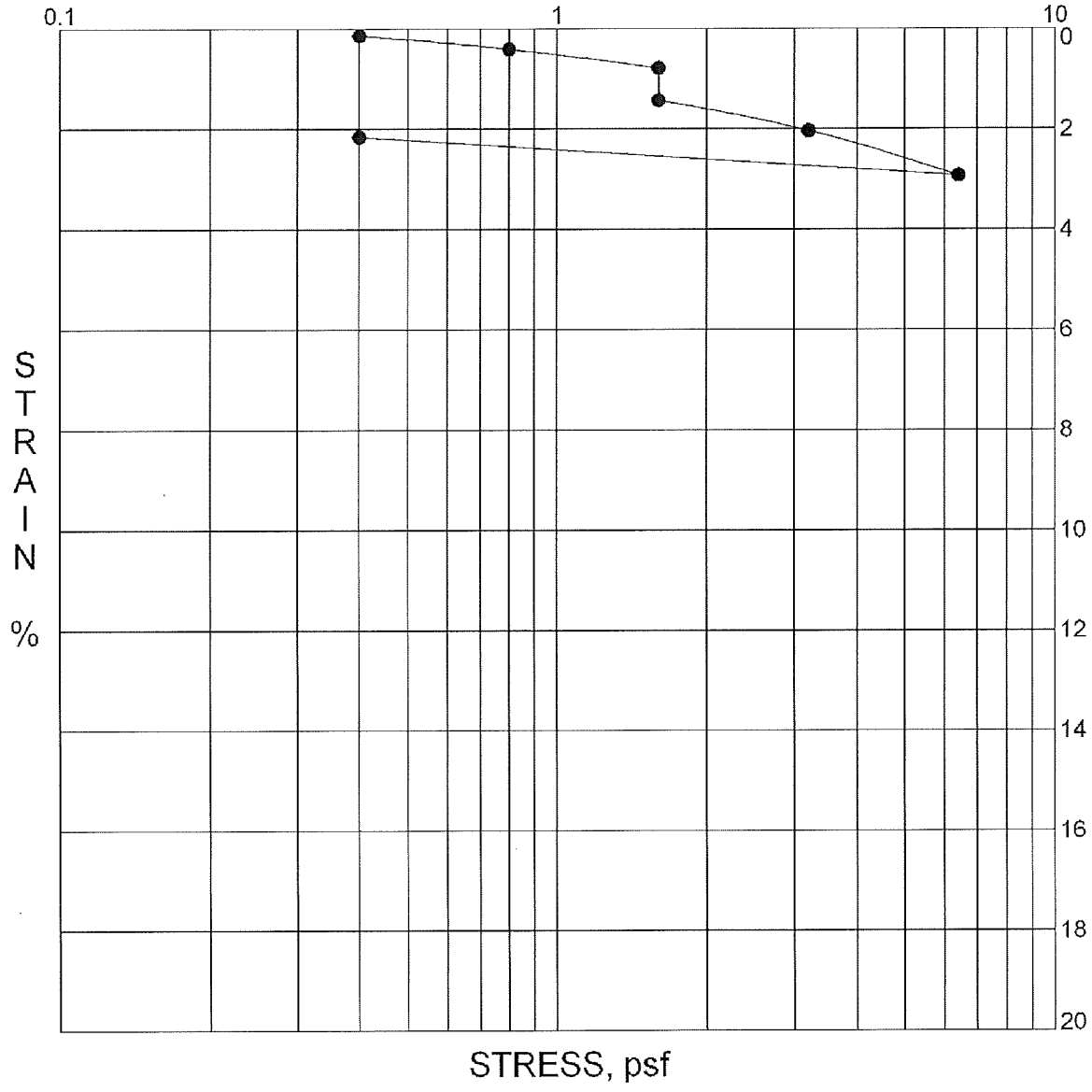
Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 6.9	Dry Density: 121.2	1600 lbs.

CONSOLIDATION TEST DIAGRAM

Figure C.3

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-3 @ 7.5 DESCRIPTION: Qal



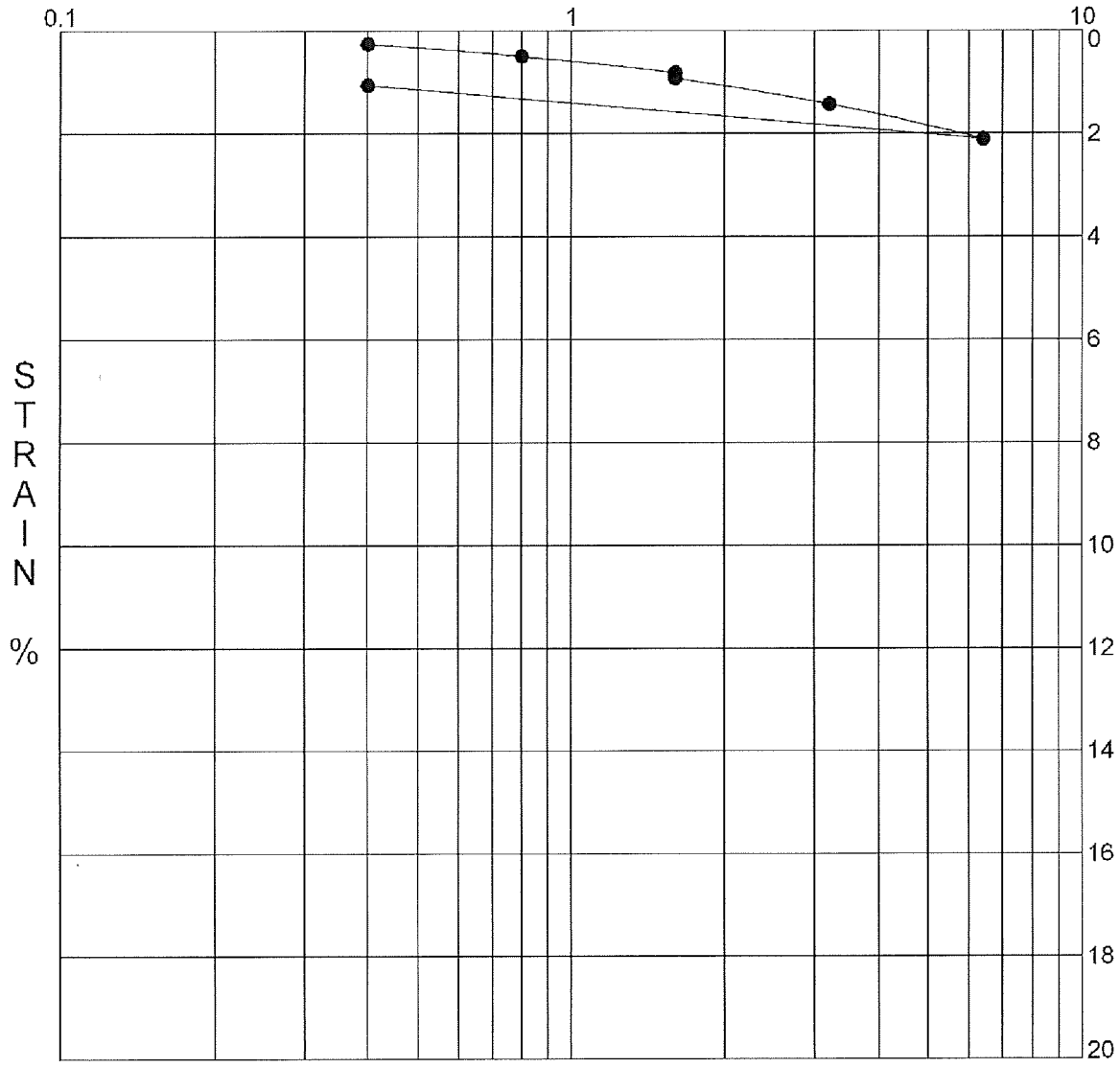
Test Results

Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 4.1	Dry Density: 109.7	**1600 lbs.**

CONSOLIDATION TEST DIAGRAM Figure C.4

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-4 @ 10.0 DESCRIPTION: Qal



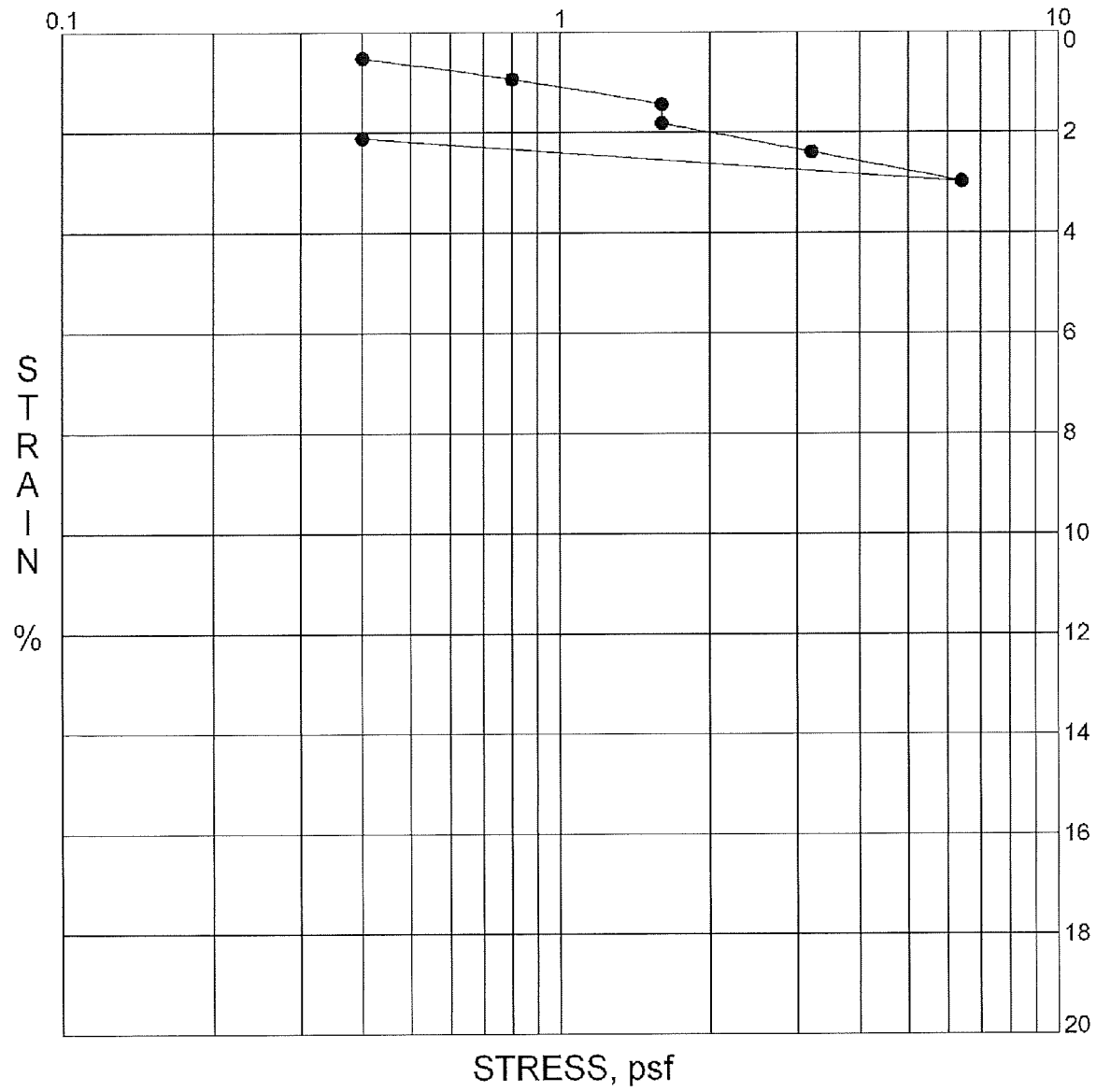
Test Results

Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 9.0	Dry Density: 105.0	**1600 lbs.**

CONSOLIDATION TEST DIAGRAM Figure C.5

PROJECT LOCATION: 1000 North Azusa Avenue PROJECT NO.: 5071

SAMPLE LOCATION: B-5 @ 10.0 DESCRIPTION: Qal



Test Results

Moisture Content (%)	Density (pcf)	Water Added At
Insitu: 2.7	Dry Density: 107.2	**1600 lbs.**

CONSOLIDATION TEST DIAGRAM Figure C.6

APPENDIX III

ANALYSES

Bearing Capacity

Lateral Design

Seismic Evaluation

BEARING CAPACITY ANALYSIS

CALCULATE THE ULTIMATE AND ALLOWABLE BEARING CAPACITIES OF THE BEARING MATERIAL LISTED BELOW USING HANSEN'S METHOD. (REFERENCE: J. BOWLES, *FOUNDATION ANALYSIS AND DESIGN*, 1988, p. 188-194).

CALCULATION PARAMETERS

EARTH MATERIAL:	Qal	EMBEDMENT DEPTH:	2 feet
SHEAR DIAGRAM:	B-3@7.5	PAD LENGTH:	2 feet
COHESION:	50 psf	PAD WIDTH:	2 feet
PHI ANGLE:	30 degrees	SLOPE ANGLE:	0 degrees
DENSITY:	115 pcf	PAD INCLINATION:	0 degrees
SAFETY FACTOR:	5		
FOOTING TYPE:	P Pad		

CALCULATED RESULTS

HANSEN'S SHAPE, DEPTH, AND INCLINATION FACTORS

Nq =	18.40	Dq =	1.29	Sy =	0.60
Nc =	30.14	Gc =	1.00	Dy =	1.00
Ny =	15.07	Bc =	1.00	Iy =	1.00
Sc =	1.61	Iq =	1.00	Gy =	1.00
Sq =	1.58	Ic =	1.00	Gq =	1.00
Dc =	1.40	Bq =	1.00	By =	1.00

CALCULATED ULTIMATE BEARING CAPACITY (Qult)	13,040.5 pounds
ALLOWABLE BEARING CAPACITY (Qa = Qult / fs)	2,608.1 pounds
PERCENT INCREASE FOR EMBEDMENT DEPTH	32.5%

BEARING CAPACITY ANALYSIS

CALCULATE THE ULTIMATE AND ALLOWABLE BEARING CAPACITIES OF THE BEARING MATERIAL LISTED BELOW USING HANSEN'S METHOD. (REFERENCE: J. BOWLES, *FOUNDATION ANALYSIS AND DESIGN*, 1988, p. 188-194).

CALCULATION PARAMETERS

EARTH MATERIAL:	Qal	EMBEDMENT DEPTH:	2 feet
SHEAR DIAGRAM:	B-3@7.5	FOOTING LENGTH:	100 feet
COHESION:	50 psf	FOOTING WIDTH:	2 feet
PHI ANGLE:	30 degrees	SLOPE ANGLE:	0 degrees
DENSITY:	115 pcf	FOOTING INCLINATION:	0 degrees
SAFETY FACTOR:	5		
FOOTING TYPE:	S Strip		

CALCULATED RESULTS

HANSEN'S SHAPE, DEPTH, AND INCLINATION FACTORS

Nq =	18.40	Dq =	1.29	Sy =	0.99
Nc =	30.14	Gc =	1.00	Dy =	1.00
Ny =	15.07	Bc =	1.00	Iy =	1.00
Sc =	1.01	Iq =	1.00	Gy =	1.00
Sq =	1.01	Ic =	1.00	Gq =	1.00
Dc =	1.40	Bq =	1.00	By =	1.00

CALCULATED ULTIMATE BEARING CAPACITY (Qult)	9,371.7 pounds
ALLOWABLE BEARING CAPACITY (Qa = Qult / fs)	1,874.3 pounds
PERCENT INCREASE FOR EMBEDMENT DEPTH	29.0%

PASSIVE EARTH PRESSURE

USE RANKINE'S METHOD TO CALCULATE THE PASSIVE EARTH PRESSURE. USE THE PROCEDURE IN NAVFAC DM-7, 1982, (p 7.2-21, Figure 2).

CALCULATION PARAMETERS

EARTH MATERIAL:	Qal	SAFETY FACTOR (fs):	1.5
SHEAR DIAGRAM:	B-3@7.5	INITIAL SEARCH DEPTH:	1
COHESION:	50 psf	FINAL SEARCH DEPTH:	5
PHI ANGLE:	30 degrees	LIMIT PASSIVE (Y OR N):	Y
DENSITY:	115 pcf	MAXIMUM PASSIVE:	100,000.0 pounds
		Cd (C/fs):	33.3 psf
		PhiD = atan(tan(phi)/fs) =	21.1 degrees

FOOTING DEPTH (feet)	TOTAL PASSIVE FORCE Pp (pounds)	PASSIVE EARTH PRESSURE AT DEPTH - SigmaP (psf)	INCREASE IN PASSIVE EARTH PRESSURE WITH EMBEDMENT DEPTH (psf/f)
1	219.1	341.0	341.0
2	682.1	585.0	243.9
3	1,389.0	828.9	243.9
4	2,339.8	1,072.8	243.9
5	3,534.6	1,316.8	243.9

TEMPORARY EXCAVATION HEIGHT

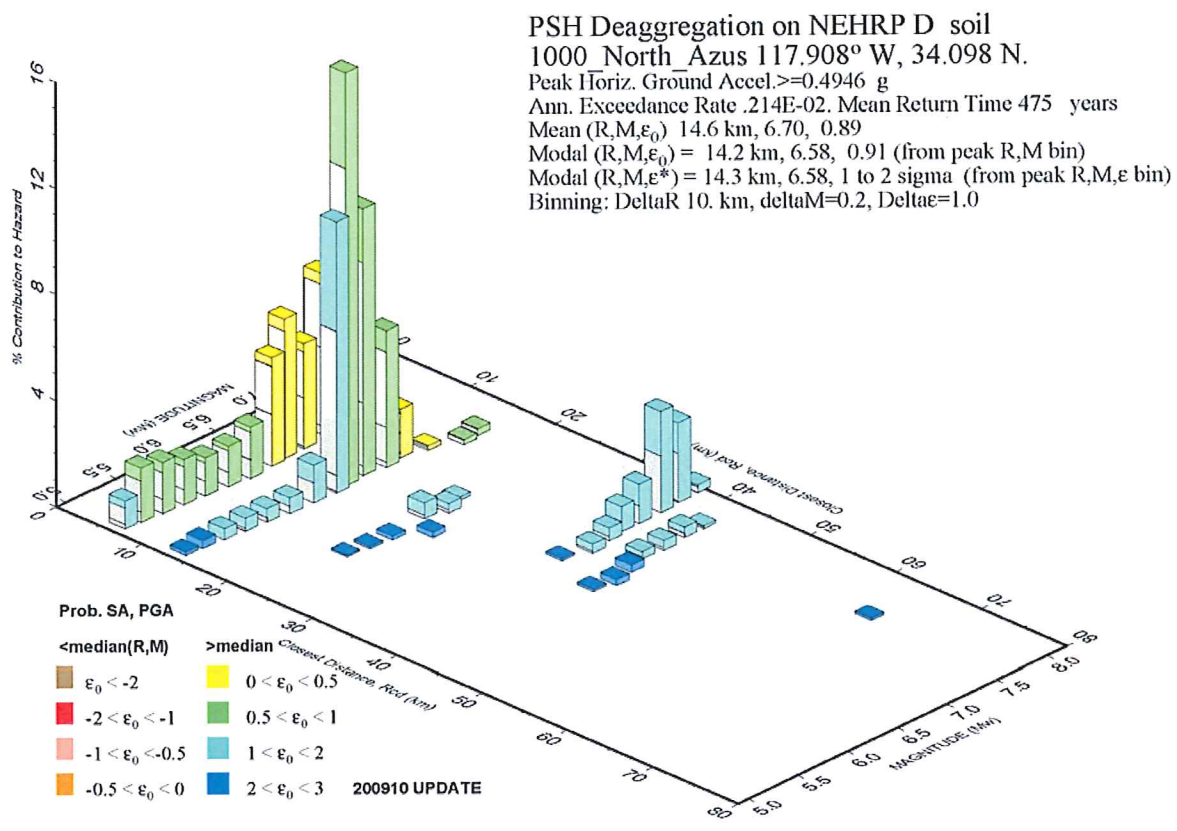
CALCULATE THE HEIGHT TO WHICH TEMPORARY EXCAVATIONS ARE STABLE (NEGATIVE THRUST). THE EXCAVATION HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. ASSUME THE EARTH MATERIAL IS SATURATED WITH NO EXCESS HYDROSTATIC PRESSURE.

CALCULATION PARAMETERS

EARTH MATERIAL:	Qal	WALL HEIGHT:	5 feet
SHEAR DIAGRAM:	B-3@7.5	BACKSLOPE ANGLE:	0 degrees
COHESION:	50 psf	SURCHARGE:	0 pounds
PHI ANGLE:	30 degrees	SURCHARGE TYPE:	U Uniform
DENSITY:	115 pcf	INITIAL FAILURE ANGLE:	20 degrees
SAFETY FACTOR:	1.25	FINAL FAILURE ANGLE:	70 degrees
WALL FRICTION:	0 degrees	INITIAL TENSION CRACK:	4 feet
CD (C/FS):	40.0 psf	FINAL TENSION CRACK:	30 feet
PHID = ATAN(TAN(PHI)/FS) =	24.8 degrees		

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	36 degrees
AREA OF TRIAL FAILURE WEDGE	6.2 square feet
TOTAL EXTERNAL SURCHARGE	0.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	711.6 pounds
NUMBER OF TRIAL WEDGES ANALYZED	4131 trials
LENGTH OF FAILURE PLANE	4.9 feet
DEPTH OF TENSION CRACK	0.1 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	4.0 feet
CALCULATED HORIZONTAL THRUST	**-42.0 pounds**
CALCULATED EQUIVALENT FLUID PRESSURE	**-9.3 pcf**
MAXIMUM HEIGHT OF TEMPORARY EXCAVATION	**3.0 feet**



GMT 2015 Dec 4 16:56:48 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 325. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

USGS Design Maps Detailed Report

ASCE 7-10 Standard (34.09775°N, 117.90765°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_s) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_s = 2.118$ g

From Figure 22-2 [2] $S_1 = 0.714$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\overline{v}_s$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\overline{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_S

For Site Class = D and S_S = 2.118 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.714 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 2.118 = 2.118$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.714 = 1.071$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

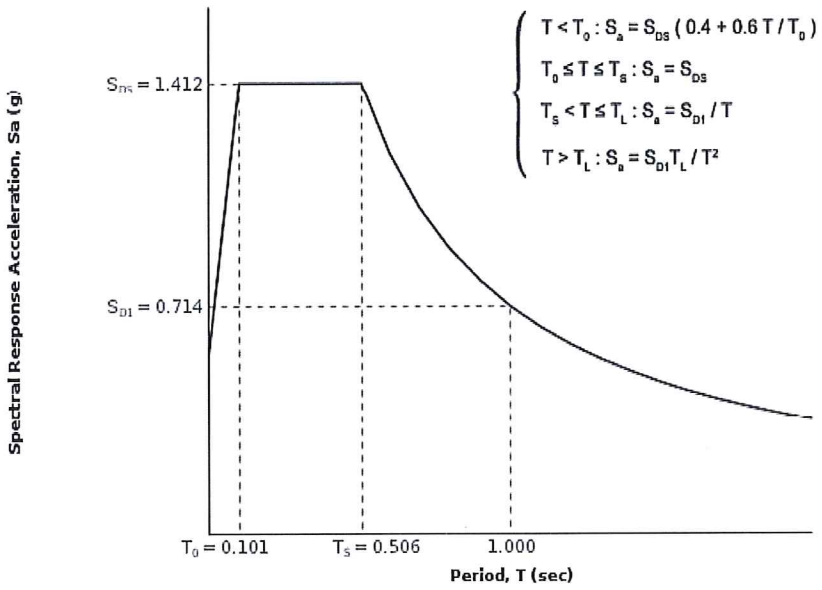
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 2.118 = 1.412$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 1.071 = 0.714$ g

Section 11.4.5 — Design Response Spectrum

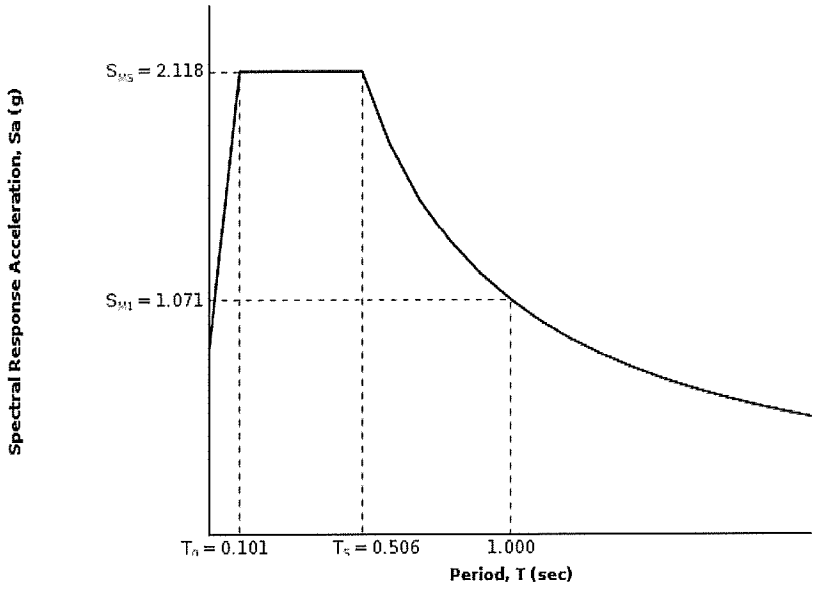
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.756

Equation (11.8-1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.756 = 0.756$ g

Table 11.8-1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.756 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.022

From Figure 22-18 [6] C_{R1} = 1.032

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.412 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.714 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX IV

REFERENCES

1. Bowles, Joseph, E., Foundation Analysis and Design (McGraw-Hill, New York: 1988).
2. California Department of Conservation, Division of Mines and Geology, 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.
3. Lamar, D. L., 1991, Geology of the Elysian Park-Repetto Hills Area, Los Angeles County California: California Division of mines and geology, Special Report 101.
4. Hoots, H. W., 1930, Geology of the eastern part of the Santa Monica Mountains, Los Angeles County, California: U. S. Geological Survey, Professional Paper 165-C.
5. Monahan, Edward J., PE, Construction of and on Compacted Fills (Wiley & Sons, New York: 1986).
6. Naval Facilities Engineering Command Foundations and Earth Structures - Design Manual 7.02 (Naval Publications and Forms Center, Philadelphia: 1986).
7. Northridge Earthquake January 17, 1994, preliminary reconnaissance report: Earthquake Engineering Research Institute, March 1994.
8. Poulos, H. G., and Davis, E. H., Pile Foundation Analysis and Design (Wiley & Sons, New York: 1980).
9. Taylor, Donald W., Fundamentals of Soil Mechanics (Wiley & Sons, New York: 1948).
10. Terzaghi, Karl, Peck, Ralph B., Mesri, Gholamreza, Soil Mechanics in Engineering Practice (Wiley & Sons, New York: 1996).

GeoConcepts INC
Geology - Geotechnical Engineering

December 20, 2018 Project 5071

PKL Investments LLC
2863 Maricopa Street
Torrance, California 90503

Subject: **INFILTRATION TEST REPORT**
1000 North Azusa Avenue
Covina, California

References:

1) Preliminary Geologic and Soils Engineering report by GeoConcepts, Inc. covering the subject site, dated December 7, 2015.

Dear Gentlemen:

Pursuant to your request, presented herein is a summary of the findings from logging and performing infiltration tests for the proposed subsurface infiltration system. It is our understanding that the proposed infiltration system will be designed to infiltrate first storm runoff into the ground. It is our understanding that the proposed infiltration trenches will be about 10 feet below the existing grade. Two test pits were excavated to a depth of 10 feet on December 3, 2018 in the general area of the proposed infiltration. The test pits location is plotted on the attached Plot Map.

The test pits encountered fill and alluvium to the depth of the test pit logging. Encountered fill had a thickness of 3.5 feet and consists predominantly of silty sand. Encountered alluvium deposits consist predominantly of silty sand. These soils are considered relatively homogenous in that no discernible layering, structure, fabric, texture, or changes in the soil type was encountered that would affect the rate or direction of water movement.

There is no evidence of near-surface groundwater nor did the subsurface exploration encounter groundwater. Highest historic groundwater onsite obtained from the State of California Seismic Hazard Zone maps is about 175 feet deep. The subject site is not located within a liquefaction zone on the State of California Seismic Hazard Zones Map of the Baldwin Park Quadrangle.

The infiltration testing was performed in the bottom of the test pit utilizing the County Method. The results of the testing are below.

Test Pit No.	Design Infiltration Rate (in/hour)	Test Material	Tested Depth (ft)
1	3.3	Qal	10.0
2	1.3	Qal	10.0

*Design Rate based on measured infiltration rate after corrections

This testing was performed using metropolitan water. Therefore, the rates will vary over time. It is recommended that conventional drainage systems be incorporated into the design of the project as a backup to ensure proper drainage of the site.

The proposed infiltration trenches shall be located a minimum of ten feet from adjacent private property lines as well as any existing or proposed structures and shall contain an overflow drain that conducts the overflow drainage to the street per the Building Code.

The following infiltration design guidelines are considered as minimums:

1. Water infiltration into the ground must be a minimum of 10 feet above the groundwater table.

2. The distance between the infiltration facility and the adjacent private property line shall be a minimum of 10 feet. Note if any buildings, subterranean walls or deep basements exist on the adjacent property a greater distance may be required.

3. Foundations shall be set back a minimum of 10 feet from the infiltration facility and the bottom of the footing shall be a minimum of 10 feet from expected zone of saturation.

4. No infiltration facility shall be placed to infiltrate into fill material.

5. The infiltration facility shall be designed to overflow to the street in the event that the drainage capacity is exceeded or in case of future failure to adequately infiltrate.

Findings

1. Based on the relatively homogeneous nature of the soils infiltration at the subject site has a low potential for creating a perched water condition that may adversely affect structures.

2. Infiltration in the area depicted on the Plot Map will not saturate soils supported by retaining/basement walls.

3. Expansive soils are not present in the area of the proposed infiltration.

4. The soils encountered in the explorations are not subject to hydroconsolidation that may adversely affect the proposed structures.

5. The soils encountered in the explorations are not subject to ground settlement due to saturation from infiltration that will result in distress to proposed structures.

Conclusions

1. The proposed site is considered suitable for storm water infiltration at or below a depth of 10 feet.

2. The infiltration of storm water will not result in ground settlement that could adversely affect structures, either on or adjacent to the site.

3. The infiltration of storm water will not result in soil saturation that could affect retaining/basement structures.

Should you have any questions regarding this report, please do not hesitate to contact the undersigned at your convenience.

Respectfully submitted,
GEOCONCEPTS, INC.

Raffi Dermendjian
Project Engineer
PE C. 88261
RD/SJW: 5071-2

Scott J. Walter
Principal Engineer
GE 2476

Enclosures: Location Map
Test Pit Logs
Plot Map

Distribution: (1) Addressee
(2) Land Development Consultants

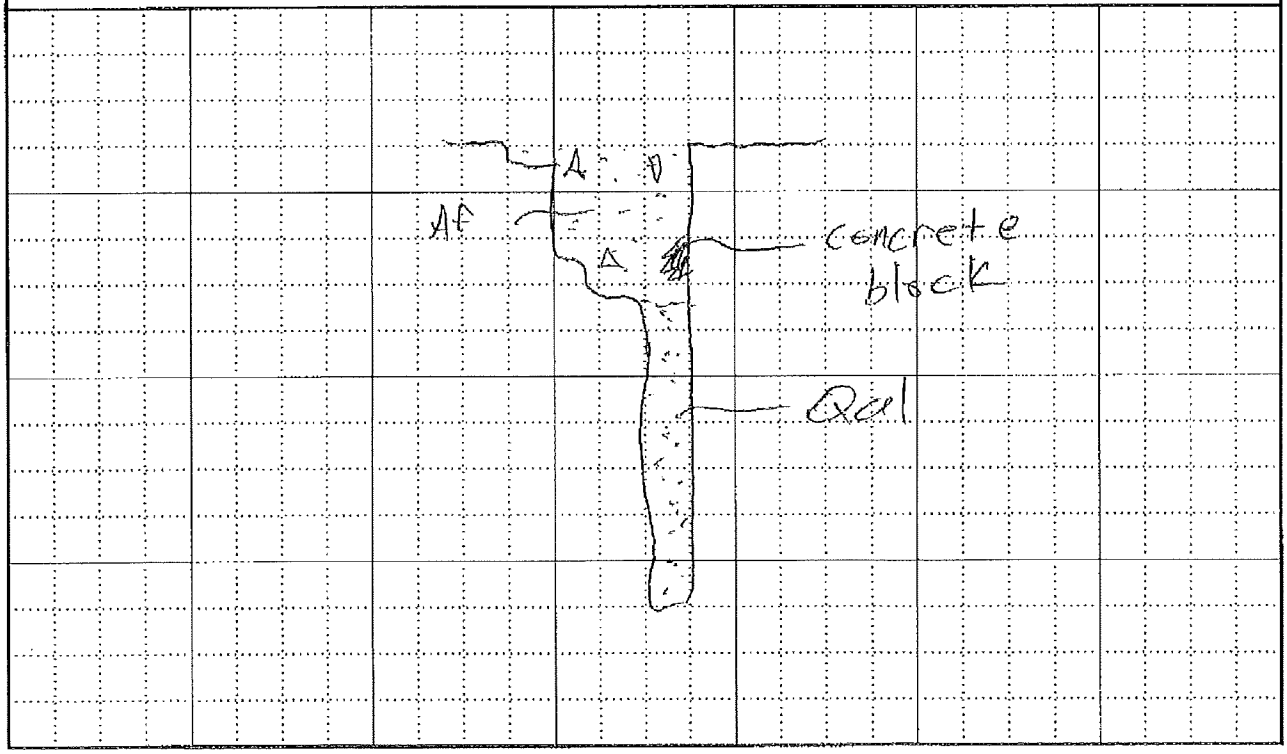
EXPLORATION: TP-1

PROJECT: 1000 North Azusa Avenue | PROJECT NO.: 5071

DATE: December 3, 2018 | LOGGED BY: RD

ATTITUDE	DESCRIPTION
	0.0' - 3.5' **ARTIFICIAL FILL; Af,** silty sand, light brown, slightly moist, fine grained, few gravels 3.5' - 10.0' **ALLUVIUM; Qal,** sand to silty sand, light brown, slightly moist, fine grained
fo - foliation s - shear j - joint b - bedding	Total Depth 10.0 Feet No Water No Caving

SCALE 1"=4' **GENERALIZED PROFILE**



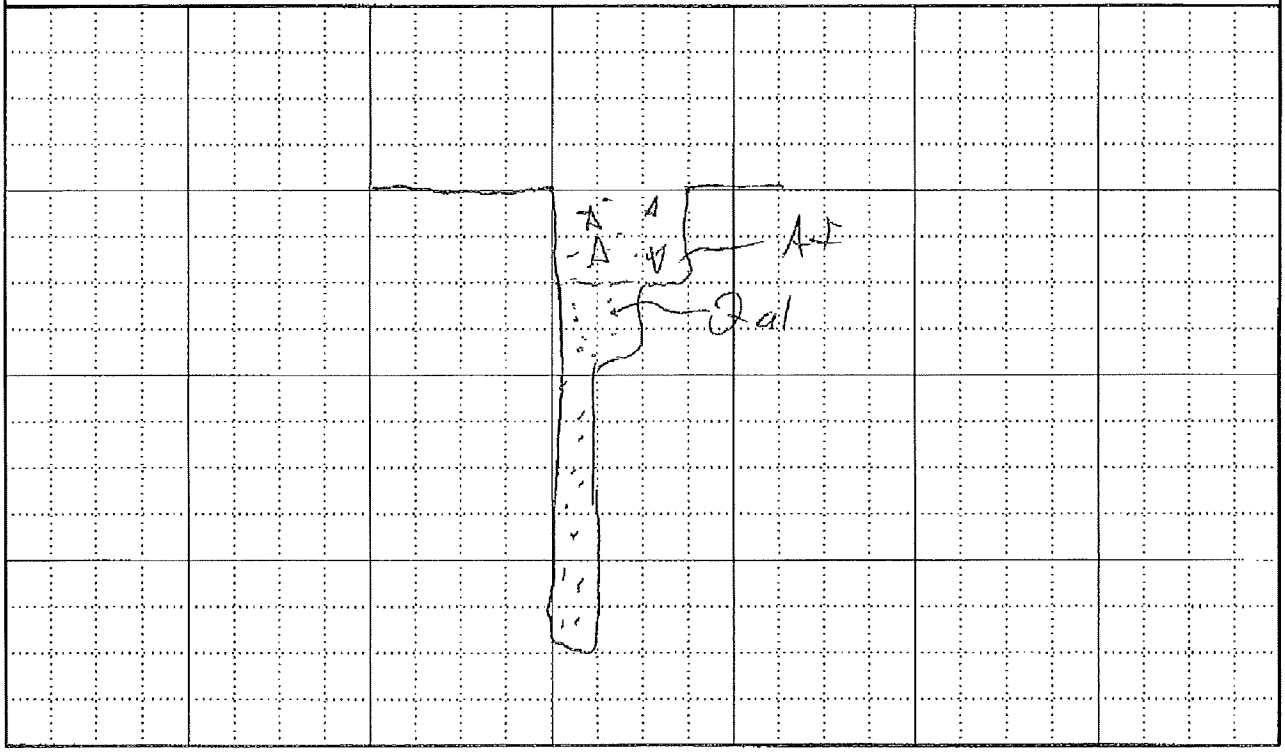
EXPLORATION: TP-2

PROJECT: 1000 North Azusa Avenue | PROJECT NO.: 5071

DATE: December 3, 2018 | LOGGED BY: RD

ATTITUDE	DESCRIPTION
	0.0' - 2.0' **ARTIFICIAL FILL; Af,** silty sand, light brown, slightly moist, fine grained, few gravels
	2.0' - 10.0' **ALLUVIUM; Qal,** silty sand, light brown, slightly moist, frequent gravels
fo - foliation s - shear j - joint b - bedding	Total Depth 10.0 Feet No Water No Caving

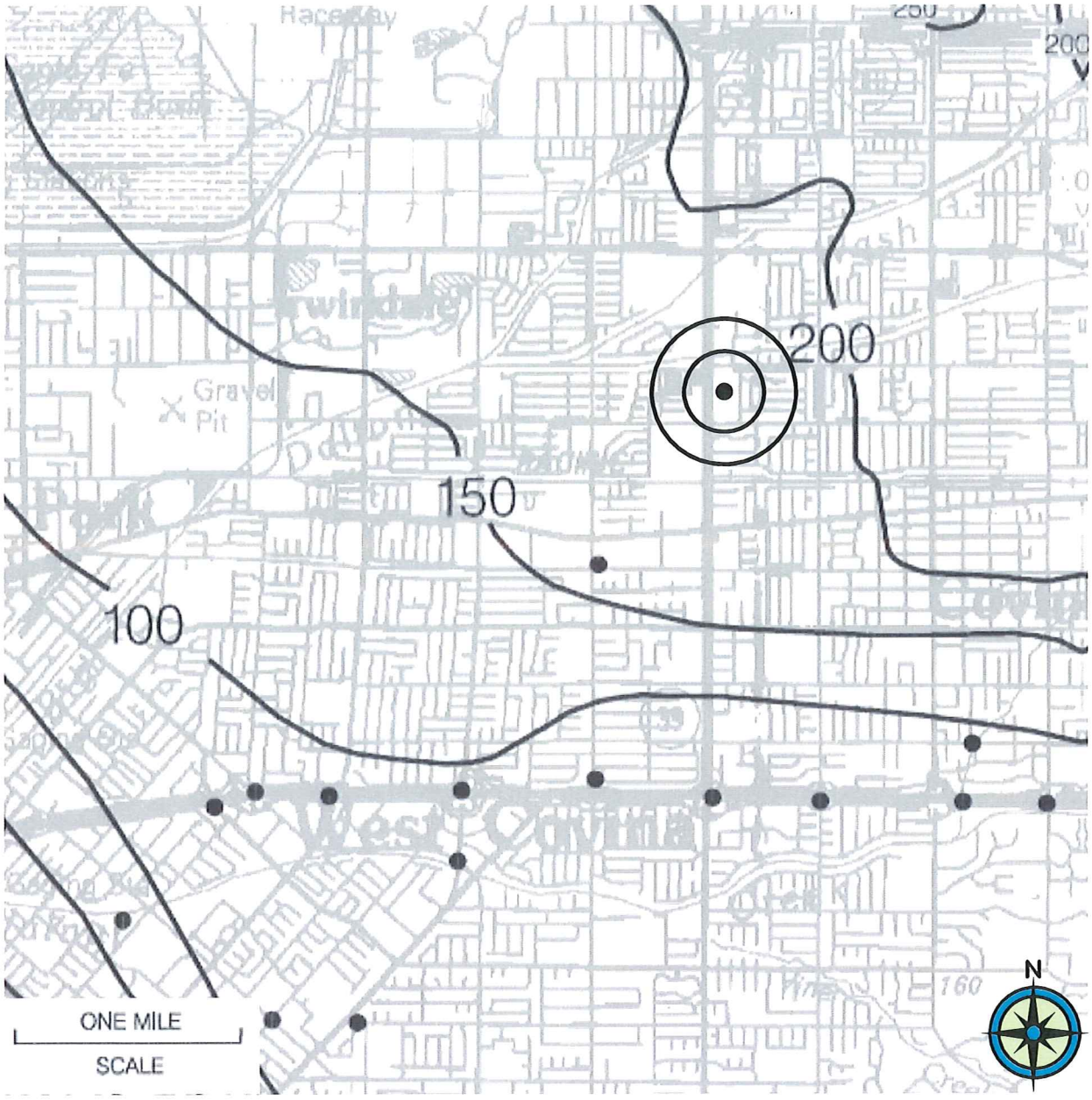
SCALE 1"=4' **GENERALIZED PROFILE**



LOCATION MAP

Reference:	County of Los Angeles, Department of Regional Planning, GIS-NET3	Scale: As Shown

GROUNDWATER MAP



Reference:	State of California Seismic Hazard Report, Baldwin Park Quadrangle	Scale: As Shown

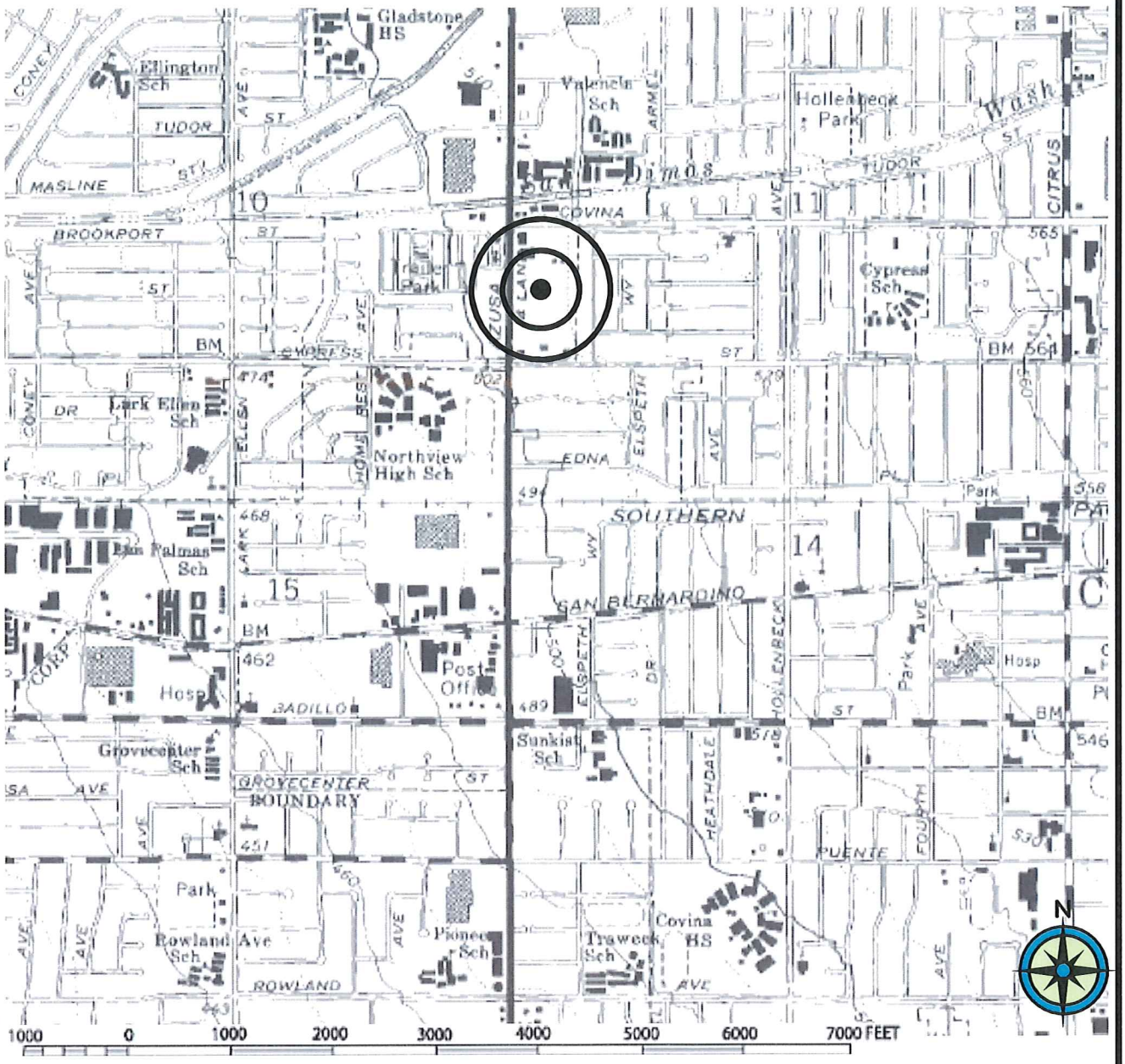
SEISMIC HAZARD MAP

Earthquake-Induced Landslides

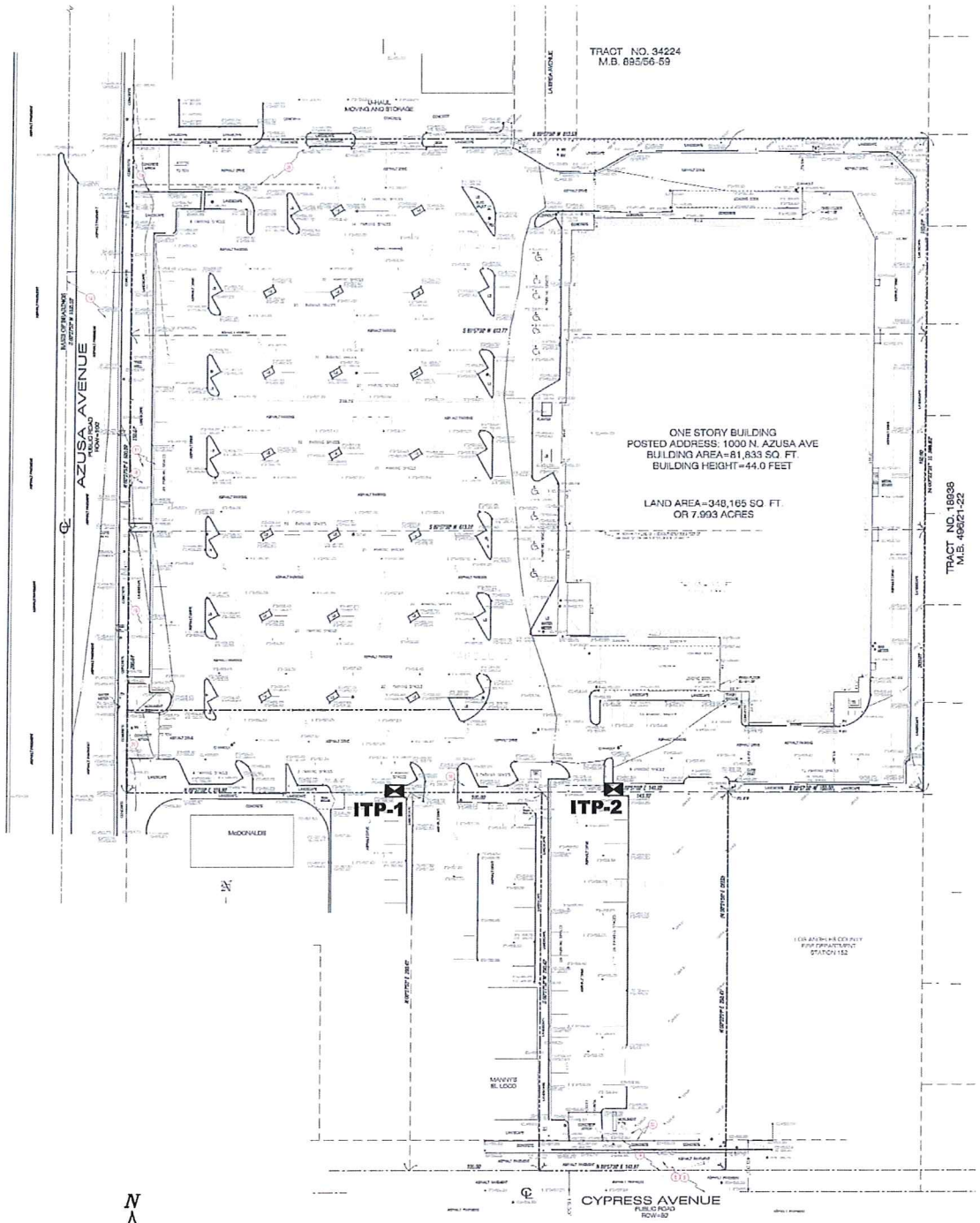
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.



Reference:	State of California, Seismic Hazard Map of the Baldwin Park Quadrangle	Scale: As Shown



Explanation	
ITP-2 ⋈	Location of Infiltration Test Pit Location

GeoConcepts INC
Geology - Geotechnical Engineering
14428 Hamlin Street, Suite 200,Van Nuys, CA 91401
Ph (818) 994-8895 | Fax (818) 994-8599 | www.GeoConceptsInc.com

Description:	Plot Map
Base Map Provided By:	Delta Surveying & Mapping
Project Address:	1000 North Azusa Avenue Covina, California
Date:	Dec. 2018
Scale:	1" = 80'
Job No.	5071-2

Attachment C

City Forms

OWNER'S CERTIFICATION
MINIMUM BMPS FOR ALL CONSTRUCTION SITES

PLAN CHECK #_____

FORM OC1

Project Name	_____	BUILDING/GRADING PERMIT NUMBER	
Project Location	_____		
Owner Name	_____	Contractor Name	See owner info
Address	_____	Address	_____
Phone	_____	Phone	_____
FAX/Email	_____	FAX/Email	_____

The National Pollutant Discharge Elimination System (NPDES) is the portion of the Clean Water Act that applies to the protection of receiving waters. Under permits from the Los Angeles Regional Water Quality Control Board (RWQCB), certain activities are subject to RWQCB enforcement. To meet the requirements of the Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit (R4-2012-0175), minimum requirements for sediment control, erosion control and construction activities must be implemented on each project site. Minimum requirements include:

- **EROSION:** Erosion from slopes and channels shall be controlled by implementing an effective combination of BMPs, such as the limiting of grading activities during the wet season; inspecting graded areas during rain events; planting and maintenance of vegetation on slopes; and covering erosion susceptible slopes.
- **SEDIMENT CONTROL:** Eroded sediments from areas disturbed by construction and from stockpiles of soil shall be retained on site to minimize sediment transport from the site to streets, drainage facilities and/or adjacent properties via runoff, vehicle tracking or wind.
- **CONSTRUCTION MATERIALS CONTROL:** Construction related materials, wastes, spills or residues shall be retained on site to minimize transport from the site to streets, drainage facilities or adjoining properties by wind or runoff. Runoff from equipment and vehicle washing shall be contained at construction sites unless treated to remove sediment and pollutants.
- **NON-STORMWATER RUNOFF:** Non-stormwater runoff from equipment and vehicle washing and any other activity shall be contained at the project site.
- **EROSION AND SEDIMENT CONTROL PLAN (ESCP):** Required for projects one acre or more. The ESCP must be developed and certified by a Qualified SWPPP Developer (QSD).
- **HILLSIDE:** Construction upon slopes 25% or more requires the implementation of additional BMPs to protect slopes and prevent erosion and sediment runoff.

Minimum BMPs include: (1) Soil piles must be covered with tarps or plastic, (2) leaking equipment must be repaired immediately, (3) refueling must be conducted away from catch basins, (4) catch basins must be protected when working nearby, (5) vacuum all concrete saw cutting, (6) never wash concrete waste into the street, (7) keep the site clean, sweep the gutters at the end of each working day and keep a trash receptacle on site.

As the engineer of record, I have selected appropriate BMPs to effectively minimize the negative impacts of this project's construction activities on stormwater quality. The project owner and contractor are aware that the selected BMPs shall be installed, monitored, and maintained to ensure their effectiveness. The BMPs not selected for implementation are redundant or deemed not applicable to the proposed construction activity.

Engineer of Record Name	Engineer of Record Signature
Title	Date

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person(s) who manage the system or those person(s) directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that submitting false and/or inaccurate information, failing to update the BMPs or ESCP to reflect conditions, or failing to properly and/or adequately implement the BMPs may result in revocation of grading and/or other permits or other sanctions provided by law.

Landowner or Agent Name	Landowner or Agent Signature
Title	Date

STORMWATER PLANNING PROGRAM

PRIORITY DEVELOPMENT & REDEVELOPMENT PROJECTS

PLAN CHECK # _____

FORM P1

Project Name _____ Project Location _____	**GENERAL PROJECT CERTIFICATION**
Company Name _____ Address _____ Contact Name / Title _____ Phone / FAX / Email _____	*A completed original of this form must accompany all LID Plan submittals.*

Best Management Practices (BMPs) have been incorporated into the design/maintenance/construction of this project to accomplish the following:

1. Minimize impacts from stormwater runoff on the biological integrity of Natural Drainage Systems and water bodies in accordance with requirements under CEQA (Cal. Pub. Resources Code § 21100), CWC § 13369, CWA § 319, CWA § 402(p), CWA § 404, CZARA § 6217(g), ESA § 7, and local government ordinances.
2. Maximize the percentage of pervious surfaces to allow more percolation of stormwater into the ground.
3. Minimize the amount of stormwater directed to impermeable surfaces and to the MS4.
4. Minimize pollution emanating from parking lots through the use of appropriate Treatment Control BMPs and good housekeeping practices.
5. Minimize breeding of Vectors
6. Reduce pollutant loads in stormwater from the development site.

I certify that this Low Impact Development Plan and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered/evaluated the information submitted.

Post Construction / Maintenance Certification

As the responsible party, I certify that the proposed BMPs will be implemented, monitored and maintained to ensure their continued effectiveness. In the event of a property transfer, the new owner/lessee will be notified of the BMPs in use at this site and I will include written conditions in the sales or lease agreement, which requires the new owner (or lessee) to assume responsibility for maintenance and conduct a maintenance inspection at least once a year. The information contained herein is, to the best of my knowledge and belief, true, accurate, and complete.

In consideration of the execution of City of Covina approval of the proposed Low Impact Development (LID) Plan including any proposed treatment system, the applicant hereby agrees to indemnify, save and keep the City of Covina, its officers, agents and employees free and harmless from and against any and all claims for injury, damage, loss, liability, cost and expense of any nature whatsoever, which the City of Covina, its officers, agents, or employees may suffer, sustain, incur, pay out as a result of any and all actions, suits, proceedings, claims and demands which may be brought, made, or filed against the City of Covina, its officers, agents or employees by reason of or arising out of, or in any manner connected with any and all operations permitted by this approval. This indemnification extends to further agree that the City of Covina is not responsible for any additional requirements or restrictions due to changes in regulations, policies or enforcement practices of the California Regional Water Quality Control Board, or any other applicable regulatory agencies.

Property Owner Name	Property Owner Signature
Applicant Title	Date

PLANNING BEST MANAGEMENT PRACTICES

BMP Type	✓ if to be used
Infiltration Trench	
Bioretention with no Underdrain	
Bioinfiltration	
Drywell	
Permeable Pavement (concrete, asphalt, and pavers)	
Underground Infiltration (Proprietary)	X
Bioretention with Underdrains	
Vegetated Swale	
Vegetated Filter Strip	
Wet Detention Basin	
Constructed Wetland	
Dry Extended Detention Basin	
Proprietary Biotreatment	
Velocity Dissipation Device	
Inlet Trash Screen	
Media Filter	
Filter Insert	
Landscape Management	
Common Area Litter Control	
Common Area Catch Basin Inspection	
Street Sweeping Private Streets and Parking Lots	
Storm Drain System Stenciling and Signage	
Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction	
Design and Construct Trash and Waste Storage Areas to Reduce Pollutant Introduction	
Efficient Irrigation	
Maintenance Bays	
Vehicle and Equipment Cleaning	
Outdoor Loading/Unloading	
Protect Slopes and Channels	
Materials Management	
Vehicle and Equipment Fueling	
Other:	

STORMWATER TREATMENT CERTIFICATION

FORM P2

SITE NAME and ADDRESS

_____

_____

_____

_____

_____

Plan Check #_____

Planning #_____

APPROXIMATE PROJECT CHARACTERISTICS

Roofed Area	_____	ft^2
Roadway/Parking Area (exposed)	_____	ft^2
Landscaped/Vegetation	_____	ft^2
Other Ground Level Impervious Areas (Ex: Outdoor work or storage areas)	_____	ft^2
Other: _____	_____	ft^2
TOTAL	_____	ft^2

STRUCTURAL/TREATMENT BMPs

(attach additional sheets as necessary) or see back

Area Designation (must correspond with plans)	**Tributary Area** (ft^2)	**Average Impervious Factor**	**Estimated Flow Rate or Volume***	**Anticipated Potential Pollutants**	**Type of BMP** (include size, make, and model, if any)	**BMP Location** (briefly describe)	**Design Treatment Flow Rate or Volume Capacity**

By stamping this form, I acknowledge that each treatment BMP is provided with adequate bypass or overflow so as not to contribute to localized flooding or soil instability.

*Flow rates and volumes based on the 0.75 inch, 24-hour rain event or the 85th percentile, 24-hour rain event, whichever is greater.

I certify that I am a Professional Civil Engineer registered in the State of California, and that the treatment methods and capacities herein comply with the requirements established by the California Regional Water Quality Control Board, Los Angeles Region, and the State Water Resources Control Board for Low Impact Development (LID) Plans.

Affix Registered Engineer Wet Ink Stamp Here:

Print Name _____ **Signature** _____ **Date** _____

STRUCTURAL/TREATMENT BMPs

(attach additional sheets as necessary)

Area Designation (must correspond with plans)	**Tributary Area** (ft^2)	**Average Impervious Factor**	**Estimated Flow Rate or Volume***	**Anticipated Potential Pollutants**	**Type of BMP** (include size, make, and model, if any)	**BMP Location** (briefly describe)	**Design Treatment Flow Rate or Volume Capacity**

Attachment D

Master Covenant Agreement (MCA)

RECORDING REQUESTED BY AND MAIL TO: CITY OF BALDWIN PARK DEPARTMENT OF PUBLIC WORKS 14403 EAST PACIFIC AVENUE BALDWIN PARK, CA 91706	

Space above this line is for Recorder's use.

COVENANT AND AGREEMENT
REGARDING THE MAINTENANCE OF LOW IMPACT DEVELOPMENT (LID) & NATIONAL POLLUTANTS DISCHARGE ELIMINATION SYSTEM (NPDES) BMPs

The undersigned, _____ ("Owner"), hereby certifies that it owns the real property described as follows ("Subject Property"), located in the County of Los Angeles, State of California:

LEGAL DESCRIPTION
ASSESSOR'S ID #: 8421-001-016 8421-001-061 TRACT NO. 82315 LOT NO. _____
ADDRESS: 1000 N. Azusa Ave & 845 W. Cypress St.

Owner is aware of the requirements of g Standards Code, Title 31, Section 4.106.4 (LID), and National Pollutant Discharge Elimination System (NPDES) permit. The following post-construction BMP features have been installed on the Subject Property:

- o Porous pavement
- o Cistern/rain barrel
- o Infiltration trench/pit
- o Bio retention or bio filtration
- o Rain garden/planter box
- o Disconnect impervious surfaces
- o Dry Well
- o Storage containers
- o Landscaping and landscape irrigation
- o Green roof
- x Other 96" Corrugated Metal Pipe (CMP) Subsurface Infiltration Basin "A", "B" & "C" Stormexx Clean Catch Basin Filters

The location, including GPS x-y coordinates, and type of each post-construction BMP feature installed on the Subject Property is identified on the site diagram attached hereto as **Exhibit 1.**

Owner hereby covenants and agrees to maintain the above-described post-construction BMP features in a good and operable condition at all times, and in accordance with the LID/NPDES Maintenance Guidelines, attached hereto as **Exhibit 2.**

Owner further covenants and agrees that the above-described post-construction BMP features shall not be removed from the Subject Property unless and until they have been replaced with other post-construction BMP features in accordance with County of Los Angeles Green Building Standards Code, and NPDES permit.

Owner further covenants and agrees that if Owner hereafter sells the Subject Property, Owner shall provide printed educational materials to the buyer regarding the post-construction BMP features that are located on the Subject Property, including the type(s) and location(s) of all such features, and instructions for properly maintaining all such features.

Owner makes this Covenant and Agreement on behalf of itself and its successors and assigns. This Covenant and Agreement shall run with the Subject Property and shall be binding upon owner, future owners, and their heirs, successors and assignees, and shall continue in effect until the release of this Covenant and Agreement by the County of Los Angeles, in its sole discretion.

Owner(s):

By:_____ Date:_____

By:_____ Date:_____
(PLEASE ATTACH NOTARY)

REFERENCE

PLAN CHECK NO.: _____ DISTRICT OFFICE NO.:_____

ATTACHMENTS

Exhibit 1

SITE BMP PLAN

Exhibit 2

LID/NPDES Maintenance Guidelines

CONTECH®
ENGINEERED SOLUTIONS

Contech® CMP Detention & Infiltration Maintenance Guide

CONTECH®
CMP DETENTION SYSTEMS

Contech® CMP Detention

Underground stormwater detention/infiltration and retention systems must be properly inspected and maintained at regular intervals for purposes of performance and longevity.

Inspection

Inspection is the key to effective maintenance and is easily performed. Contech recommends ongoing quarterly inspections. The rate at which the system collects pollutants will depend more heavily on site specific activities rather than the size or configuration of the system. Inspections should be performed more often in equipment washdown areas, in climates where sanding and/or salting operations take place, and in various other instances in which higher accumulations of sediment or abrasive / corrosive conditions may exist. Inspection and maintenance records should be maintained for the life of the system.

Maintenance

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

If inspectors observe any salt or other corrosive substance concentrations or accumulations in the system, or if salt or other corrosive substance is used or prevalent near the system, it is recommended to rinse the system above the spring line annually between late spring and early summer as part of the maintenance program. This maintenance is required for infiltration systems. Excessive salting should be avoided and pavement should be sealed to reduce salt infiltration from the surface.

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

The foregoing inspection and maintenance efforts help ensure underground pipe systems used for stormwater storage continue to function as intended by identifying recommended regular inspection and maintenance practices. Inspection and maintenance related to the structural integrity of the pipe or the soundness of pipe joint connections is beyond the scope of this guide.

Inspection & Maintenance Log Sample Template

_____" Diameter System			Location: Anywhere, USA		
Date	**Depth of Sediment**	**Accumulated Trash**	**Maintenance Performed**	**Maintenance Personnel**	**Comments**
12/01/10	2"	None	Removed Sediment	B. Johnson	Installed
03/01/11	1"	Some	Removed Sediment and Trash	B. Johnson	Swept parking lot
06/01/11	0"	None	None		
09/01/11	0"	Heavy	Removed Trash	S. Riley	
12/01/11	1"	None	Removed Sediment	S. Riley	
04/01/12	0"	None	None	S. Riley	
04/15/01	2	Some	Removed Sediment and Trash	ACE Environmental Services	

CMP DETENTION SYSTEMS

Support

Drawings and specifications are available at www.ContechES.com.
Site-specific support is available from our engineers.

CONTECH ENGINEERED SOLUTIONS
800.338.1122
www.ContechES.com

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treatment products. For information, visit www.ContechES.com or call 800.338.1122.

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

STORMEXX® CLEAN CATCH BASIN FILTER

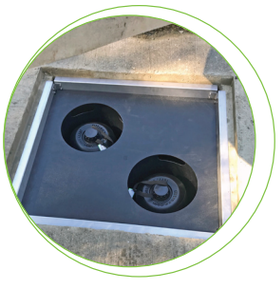
FlexStorm has partnered with Filtrexx to offer the latest in compost filter technology. The StormExx Clean Catch Basin Filter utilizes an enhanced cartridge filter for the capture and removal of sediment, hydrocarbons, heavy metals, nutrients and bacteria from stormwater runoff. The filter insert sits below the grate and will fit any round or rectangular storm drain using FlexStorm engineered framing systems.

FEATURES & BENEFITS:

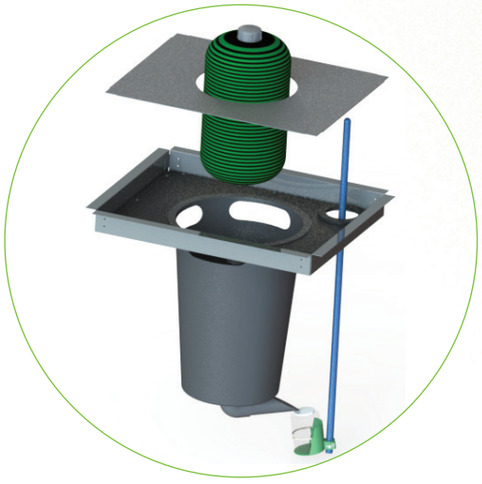
- Easy to install, maintain and replace
- Treats stormwater at the street/inlet level
- Patented multi-stage filtration system
- Option for double units
- Overflow bypass of 500+ gpm

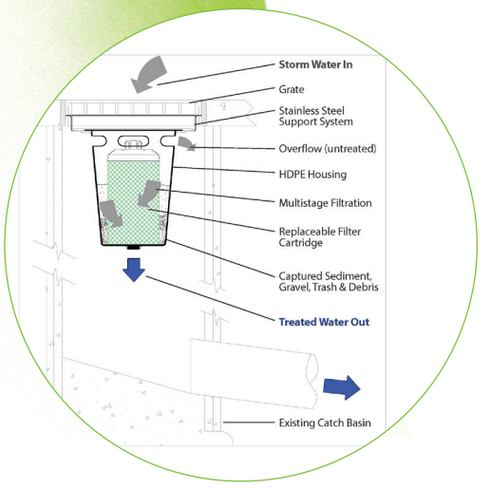
REMOVAL RATES:

- TSS: 90%
- Total Phosphorous: 59%
- Soluble Phosphorous: 94%
- Ammonium Nitrate: 41%
- Chromium: 24%
- E. Coli: 93%
- pH (low) neutralized to 6.62
- Oil/Hydrocarbons: 99%
- Copper: 75%
- Zinc: 58%
- Cadmium: 99%
- Arsenic: 18%
- Total Coliform: 79%
- pH (high) neutralized to 8.31
- Turbidity: 76%
- Nickel: 58%
- TKN: 22%
- Lead: 60%
- Selenium: 25%
- Fecal Coliform: 71%



Values are total efficiency removal percentage of typical standard input stormwater concentrations over 10 run-off events. All pollutants are common stormwater pollutants and part of industrial and municipal stormwater permit effluent limit guideline regulations. For methodology, reference Filtrexx TechLink Research Summary #3338.





*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

STORMEXX CLEAN CATCH BASIN FILTER

SUMMARY

StormExx inserts are for use at stormwater catch basins in roadways, parking lots and paved areas as indicated on the plans and specifications. The inserts remove sediment, hydrocarbons, heavy metals, nutrients and bacteria from stormwater run-off. Installer must provide size and type as required upon placing order. Inserts shall include all components required for a complete installation at each catch basin as indicated on drawings. Each insert shall include a stainless steel framing system and a replaceable filter/absorber cartridge with filter media having a combined total volume of approximately 1,200 cubic inches.

CATCH BASIN INSERT FEATURES AND CHARACTERISTICS

1. Filter Cartridge Size: Nominal 10” in diameter by 18” high with center perforated HDPE tube. Stormwater flows through media horizontally on a downward path through the filter/absorber cartridge before exiting the perforated tube. The cartridge shall slip over a perforated internal drain tube that exits through the bottom of the housing. The cartridge shall contain approximately 1,200 cubic inches of various absorbent material arranged primarily in layers. The outer surface of the cartridge shall be covered with a poly strainer fabric. Cartridge shall be easily removable for replacement. Drain tube with perforations may extend above filter/absorber portion to allow a minimum flow rate to deter standing water if unit becomes plugged or blinded.
2. Nominal Flow Rate: 15-40 gpm through clean filter/absorber cartridge. Unit features a large overflow opening area and space between housing, deflector and catch basin that allows for high overflow rates with minimum restriction during storm conditions. Overflow capable of passing several hundred gpm.
3. Nominal Flow Rate with Pre-Strainer: Where leaves and other surface material are anticipated, a pre-strainer can be used. Flow restriction can occur when pre-strainer is restricted or plugged.
4. Filter Housing: HDPE solid housing suitable for full height sediment containment and shall be nominal 15 gallons retention size. Smaller size capacity may be used on shallow catch basins. A perforated tube shall be incorporated within the housing to allow the filter/absorber cartridge to slip on for easy replacement. A locking screw-on-cap keeps cartridge in place during use. Use modified or shorter housing (with less storage, flow and filtration) where depth of catch basin is shallow or to suit basin.
5. Frame/Deflector: Each insert shall be fitted with a custom frame that directs incoming water from the grate inlet to the housing. Materials include HDPE or poly sheet and/or Type 304 SS sheet and frame.

OPERATION AND MAINTENANCE GUIDELINES

StormExx catch basin inserts are used to intercept stormwater as it passes through the grate. Heavy sediment items settle to the bottom of the housing and the collected water starts to rise and pass through the filter cartridge. As the rainfall rate increases, the water level may rise to the top of the cartridge. During high rainfall flow events excess untreated water will overflow the housing. **Note**: The most concentrated contaminants in stormwater generally occur at the beginning of each rain event. Stormwater treatment devices are frequently sized to treat this “first flush” event. Each site and installation may vary widely as to exposure to sediment, construction debris, landscaping and other pollutants.

With periodic site inspections, the proper care and maintenance frequency may be determined for a proper service schedule. The StormExx inserts should be inspected during each season before and after rain events to ensure that the insert filter assembly is ready to accept and treat stormwater run-off. Keep the grate and area within 6’ of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. This is especially important during leaf fall season as decaying leaves on the filter cartridge can shorten filter life. Periodic visual inspections involve looking through the grate to see if any standing water exists. The collected water should drain through the filter cartridge that is designed for deep bed loading. As it becomes blinded or plugged with sediment, the flow rate capability will be reduced. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6” to 8” above bottom of the 24” housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary. Collected leaves, grass clippings, sediment, debris and spent filter cartridges that are not considered hazardous may be disposed of in on-site trash bins if approved by client. Cartridge disposal shall be in accordance with applicable rules and regulations.

Advanced Drainage Systems, Inc.
1-800-821-6710 www.ads-pipe.com

FLEXSTORM www.inletfilters.com

(OPERATION, MAINTENANCE AND MONITORING PLAN)

Stormwater Quality Control

96” Diameter Perforated Underground Retention System

Owner's Association to conduct ongoing annual inspections of 96" Corrugated Metal Pipe (CMP) Subsurface Infiltration Basin. System to be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice or when any salt or other corrosive substance concentrations or accumulations are observed. Inspection, maintenance and records to be conducted according to recommendations contained in attached Contech CMP Detention & Infiltration Maintenance Guide.

Stormexx Clean Catch Basin Filters

Inserts to be installed at all roadway/parking catch basins as indicated on LID Site Plan. The inserts should be inspected during each season before and after rain events to ensure that the insert filter assembly is ready to accept and treat stormwater run-off. Keep the grate and area within 6’ of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. Periodic visual inspections involve looking through the grate to see if any standing water exists. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6” to 8” above bottom of the 24” housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary.

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
NON-STRUCTURAL SOURCE CONTROL BMPs			
Education for Property Owners, Tenants and Occupants	**Owner's Association will provide educational materials.**	**Continuous**	**Owner's Association**
Activity Restriction	**Owner's Association will provide materials outlining restricted activities.**	**Continuous**	**Owner's Association**
Common Area Landscape Management	**Construction Manager during construction. Owner's Association through its landscape maintenance firm.**	**Monthly during regular maintenance.**	**Owner's Association**
Common Area Litter Control	**Owner's Association and owners**	**Continuous**	**Owner's Association and owners**
Housekeeping of Loading Docks	**Owner's Association and owners**	**n/a**	**n/a**
Common Area Catch Basin Inspection	**Owner's Association and owners. Inspect, cleaned and maintained at 100% of the catch basins and inlets on an annual basis. Cleaning to take place in late summer/early fall.**	**Annually**	**Owner's Association and owners**
Street Sweeping Private Streets and Parking Lots	**Owner's Association to insure sweeping occurs and trash, sediment and debris is not located in gutters.**	**Weekly**	**Owner's Association**

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
STRUCTURAL SOURCE CONTROL BMPs			
(S-1) – Storm Drain Message & Signage	**The signs must be placed so they are easily visible to the public. Legibility and visibility of markers and signs should be maintained (e.g., signs should be repainted or replaced as necessary).**	**Continuous**	**Owner's Association**
(S-3) – Outdoor Trash Storage & Waste Handling Area	**Outdoor trash storage areas must be checked periodically to ensure containment of accumulated water and prevention of stormwater run-on. Contaminated accumulated water must be disposed of in accordance with applicable laws and regulations, and cannot be discharged directly to the storm drain or sanitary sewer system without appropriate permitting.**	**Continuous**	**Owner's Association**
(S-8) – Landscape Irrigation Practices	**Maintain irrigation areas to remove trash and debris and loose vegetation. Rehabilitate areas of bare soil. Inspect and maintain irrigation equipment and components to ensure proper functionality. Clean equipment as necessary to prevent algae growth and vector breeding.**	**Monthly during regular maintenance.**	**Owner's Association**
(S-9) – Building Materials Selection	**Design Considerations/Specifications of building materials to be added at design phase. The integrity of structural elements that are subject to damage (e.g., signs) must be maintained as required by local codes and ordinances.**	**Continuous**	**Owner's Association and individual owners**

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
STORMWATER QUALITY CONTROL BMPs			
(T-6) – Proprietary Treatment Control Measures	**Proprietary stormwater quality control measure vendors are constantly updating and expanding their product lines, so refer to the latest design guidance from the vendors.**	**See below.**	**Owner's Association**
Stormexx Clean Catch Basin Filter Inserts – *Advanced Drainage Systems*	**Inserts to be installed at all roadway/parking catch basins as indicated on LID Site Plan. Keep the grate and area within 6' of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. Periodic visual inspections involve looking through the grate to see if any standing water exists. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6" to 8" above bottom of the 24" housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary.**	**Continuous**	**Owner's Association**

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
96" Perforated Underground Retention System – *Contech Engineered Solutions*	**CMP detention systems should be cleaned when an inspection reveals accumulated sediment or trash is clogging the discharge orifice.** **Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. Manhole covers should be securely seated following cleaning activities. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.** **Maintaining an underground detention or infiltration system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.** **Inspect prior to and after the rainy season and 72 hours after large storm events (greater than 1-inch) to verify there is no standing water.**	**As needed**	**Owner's Association**

Attachment E

Operations and Maintenance (O&M) Plan

Tract Map No. 82315

1000 N. Azusa Ave. & 845 W. Cypress St.

Covina, CA 91722

Grading Permit No._____, Building Permit No._____

REQUIRED PERMITS

If no permits are required for implementation, operation or maintenance of the BMPs.

RECORDKEEPING

All records must be made available for review upon request.

RESPONSIBLE PARTY

The owner is aware of the maintenance responsibilities of the proposed BMPs. A funding mechanism is in place to maintain the BMPs at the frequency stated in the LID Plan. The contact information for the entity responsible is below:

Name:	
Company:	PKL Investments, LLC
Title:	Landowner
Address 1:	2863 Maricopa Street
Address 2:	Torrance, CA 90503
Phone Number:	(714) 738-0828
Email:	

(OPERATION, MAINTENANCE AND MONITORING PLAN)

Stormwater Quality Control

96” Diameter Perforated Underground Retention System

Owner's Association to conduct ongoing annual inspections of 96" Corrugated Metal Pipe (CMP) Subsurface Infiltration Basin. System to be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice or when any salt or other corrosive substance concentrations or accumulations are observed. Inspection, maintenance and records to be conducted according to recommendations contained in attached Contech CMP Detention & Infiltration Maintenance Guide.

Stormexx Clean Catch Basin Filters

Inserts to be installed at all roadway/parking catch basins as indicated on LID Site Plan. The inserts should be inspected during each season before and after rain events to ensure that the insert filter assembly is ready to accept and treat stormwater run-off. Keep the grate and area within 6’ of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. Periodic visual inspections involve looking through the grate to see if any standing water exists. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6” to 8” above bottom of the 24” housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary.

CONTECH®
ENGINEERED SOLUTIONS

Contech® CMP Detention & Infiltration Maintenance Guide

CONTECH®
CMP DETENTION SYSTEMS

Contech® CMP Detention

Underground stormwater detention/infiltration and retention systems must be properly inspected and maintained at regular intervals for purposes of performance and longevity.

Inspection

Inspection is the key to effective maintenance and is easily performed. Contech recommends ongoing quarterly inspections. The rate at which the system collects pollutants will depend more heavily on site specific activities rather than the size or configuration of the system. Inspections should be performed more often in equipment washdown areas, in climates where sanding and/or salting operations take place, and in various other instances in which higher accumulations of sediment or abrasive / corrosive conditions may exist. Inspection and maintenance records should be maintained for the life of the system.

Maintenance

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

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04/01/12	0"	None	None	S. Riley	
04/15/01	2	Some	Removed Sediment and Trash	ACE Environmental Services	

CMP DETENTION SYSTEMS

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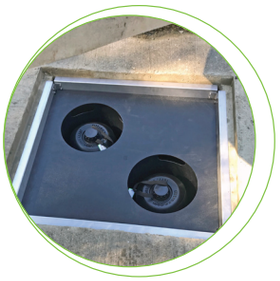

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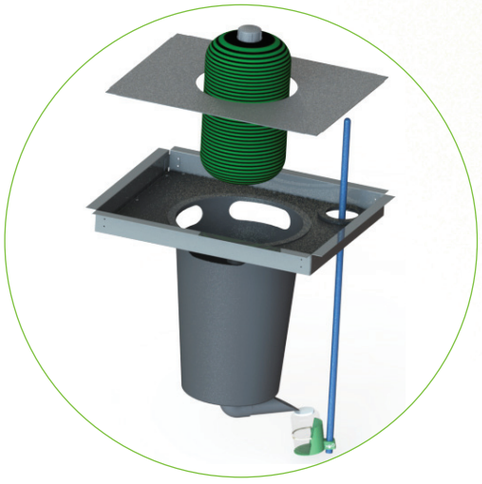

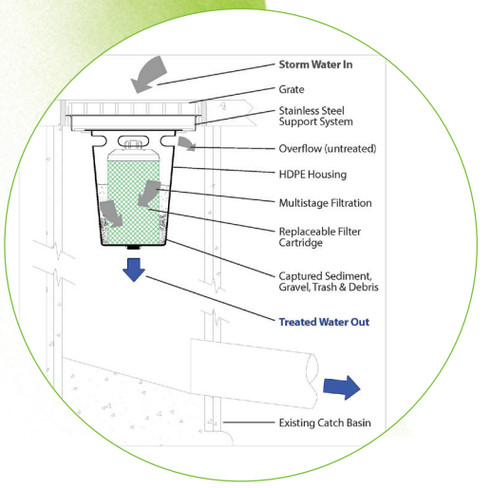

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BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
NON-STRUCTURAL SOURCE CONTROL BMPs			
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Activity Restriction	**Owner's Association will provide materials outlining restricted activities.**	**Continuous**	**Owner's Association**
Common Area Landscape Management	**Construction Manager during construction. Owner's Association through its landscape maintenance firm.**	**Monthly during regular maintenance.**	**Owner's Association**
Common Area Litter Control	**Owner's Association and owners**	**Continuous**	**Owner's Association and owners**
Housekeeping of Loading Docks	**Owner's Association and owners**	**n/a**	**n/a**
Common Area Catch Basin Inspection	**Owner's Association and owners. Inspect, cleaned and maintained at 100% of the catch basins and inlets on an annual basis. Cleaning to take place in late summer/early fall.**	**Annually**	**Owner's Association and owners**
Street Sweeping Private Streets and Parking Lots	**Owner's Association to insure sweeping occurs and trash, sediment and debris is not located in gutters.**	**Weekly**	**Owner's Association**

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
STRUCTURAL SOURCE CONTROL BMPs			
(S-1) – Storm Drain Message & Signage	**The signs must be placed so they are easily visible to the public. Legibility and visibility of markers and signs should be maintained (e.g., signs should be repainted or replaced as necessary).**	**Continuous**	**Owner's Association**
(S-3) – Outdoor Trash Storage & Waste Handling Area	**Outdoor trash storage areas must be checked periodically to ensure containment of accumulated water and prevention of stormwater run-on. Contaminated accumulated water must be disposed of in accordance with applicable laws and regulations, and cannot be discharged directly to the storm drain or sanitary sewer system without appropriate permitting.**	**Continuous**	**Owner's Association**
(S-8) – Landscape Irrigation Practices	**Maintain irrigation areas to remove trash and debris and loose vegetation. Rehabilitate areas of bare soil. Inspect and maintain irrigation equipment and components to ensure proper functionality. Clean equipment as necessary to prevent algae growth and vector breeding.**	**Monthly during regular maintenance.**	**Owner's Association**
(S-9) – Building Materials Selection	**Design Considerations/Specifications of building materials to be added at design phase. The integrity of structural elements that are subject to damage (e.g., signs) must be maintained as required by local codes and ordinances.**	**Continuous**	**Owner's Association and individual owners**

BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
STORMWATER QUALITY CONTROL BMPs			
(T-6) – Proprietary Treatment Control Measures	**Proprietary stormwater quality control measure vendors are constantly updating and expanding their product lines, so refer to the latest design guidance from the vendors.**	**See below.**	**Owner's Association**
Stormexx Clean Catch Basin Filter Inserts – *Advanced Drainage Systems*	**Inserts to be installed at all roadway/parking catch basins as indicated on LID Site Plan. Keep the grate and area within 6' of the grate clean and free of leaves, grass clippings, sediment and debris to minimize these contaminants from entering the unit housing. Periodic visual inspections involve looking through the grate to see if any standing water exists. Replace filter cartridge if standing water is in the housing. Maintenance schedules will vary with rainfall and pollutant concentration levels. Typical post-construction installations will require cartridge change-outs once or twice per year. If sediment reaches a height of 6" to 8" above bottom of the 24" housing, the sediment should be dumped and the filter cartridge inspected and replaced if necessary.**	**Continuous**	**Owner's Association**

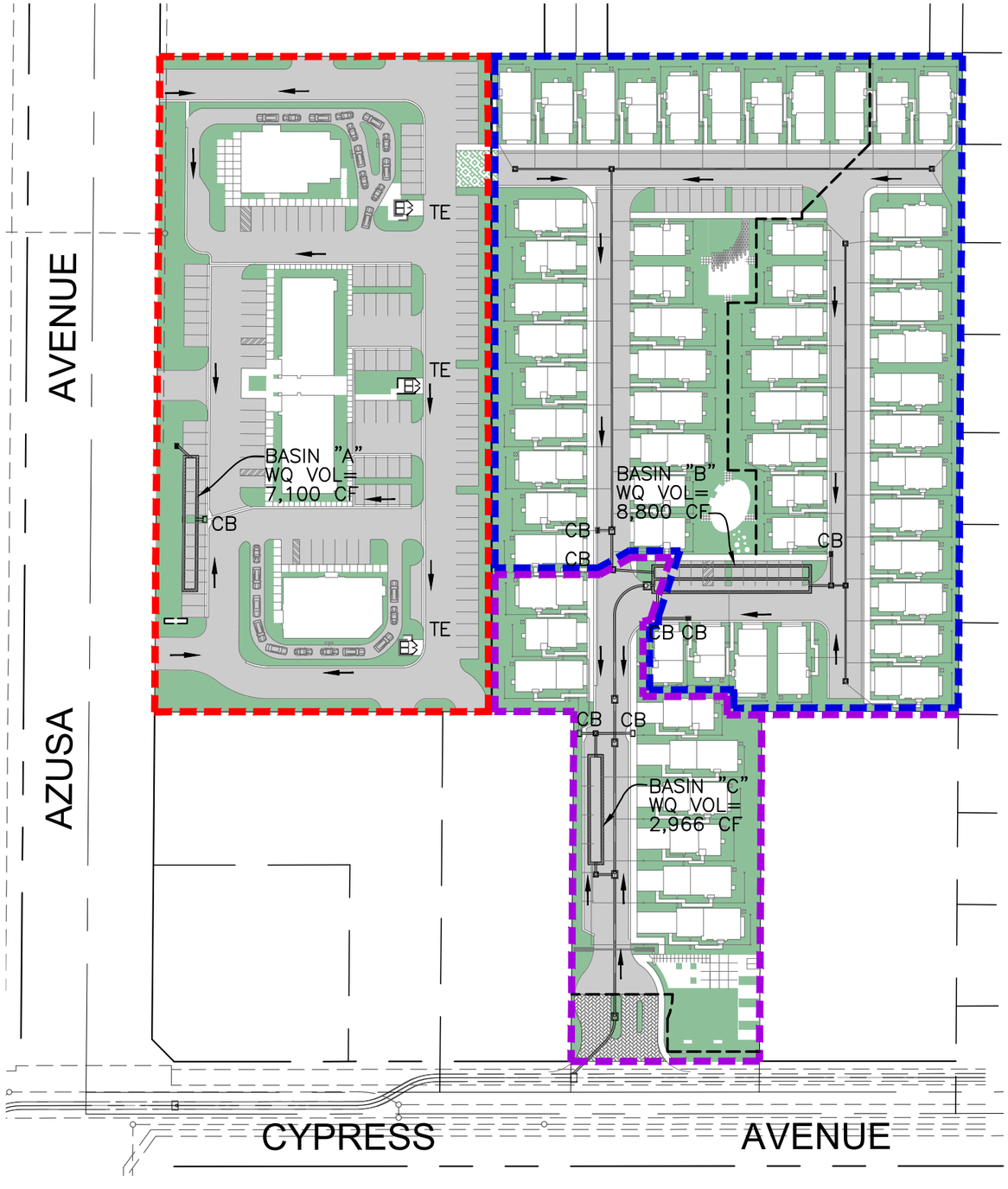
BMP Name	BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
96" Perforated Underground Retention System – *Contech Engineered Solutions*	**CMP detention systems should be cleaned when an inspection reveals accumulated sediment or trash is clogging the discharge orifice.** **Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. Manhole covers should be securely seated following cleaning activities. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.** **Maintaining an underground detention or infiltration system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.** **Inspect prior to and after the rainy season and 72 hours after large storm events (greater than 1-inch) to verify there is no standing water.**	**As needed**	**Owner's Association**

Attachment F

Plans

LID SITE PLAN

TRACT NO. 82315
COVINA, CA



CATCH BASIN NOTE:

FILTER INSERTS AND (S-1) STORM DRAIN MESSAGE & SIGNAGE TO BE INSTALLED AT EACH CATCH BASIN IDENTIFIED HEREON AND AS OUTLINED IN REPORT.

SOURCE CONTROL BMPs:

(S-1) – STORM DRAIN MESSAGE & SIGNAGE
(S-3) – OUTDOOR TRASH STORAGE AREA
(S-8) – LANDSCAPE IRRIGATION PRACTICES
(S-9) – BUILDING MATERIALS SELECTION

STORMWATER QUALITY CONTROL BMPs:

(T-6) – PROPRIETARY TREATMENT CONTROL MEASURES

* ADS STORMEXX CLEAN CATCH BASIN FILTER INSERTS
* 96" PERFORATED UNDERGROUND RETENTION SYSTEM

DMA 1:

PERVIOUS AREA – 37,674 S.F.
IMPERVIOUS AREA – 89,894 S.F.
0.4849 CFS (1" RAINFALL)
VM = 7,002 FT^3

DMA 2:

PERVIOUS AREA – 55,311 S.F.
IMPERVIOUS AREA – 109,033 S.F.
0.5607 CFS (1" RAINFALL)
VM = 8,556 FT^3

DMA 3:

PERVIOUS AREA – 17,796 S.F.
IMPERVIOUS AREA – 35,078 S.F.
0.2318 CFS (1" RAINFALL)
VM = 2,746 FT^3

N

GRAPHIC SCALE

100 50 0 100 200

SCALE IN FEET
1 inch = 100 ft.

LEGEND:

– LANDSCAPE AREAS
– STREET SWEEPING (PRIVATE STREETS & PARKING LOTS)
– DRAINAGE SUB-AREAS
CB – CATCH BASIN
TE – TRASH ENCLOSURE
– DIRECTION OF FLOW

LAND DEVELOPMENT CONSULTANTS
LAND PLANNERS
SURVEYORS
CIVIL ENGINEERS
1520 BROOKHOLLOW DRIVE, SUITE 33
SANTA ANA, CA 92705
(714) 557-7700 (714) 557-7707 FAX

LID SITE PLAN
TRACT NO. 82315
COVINA, CA

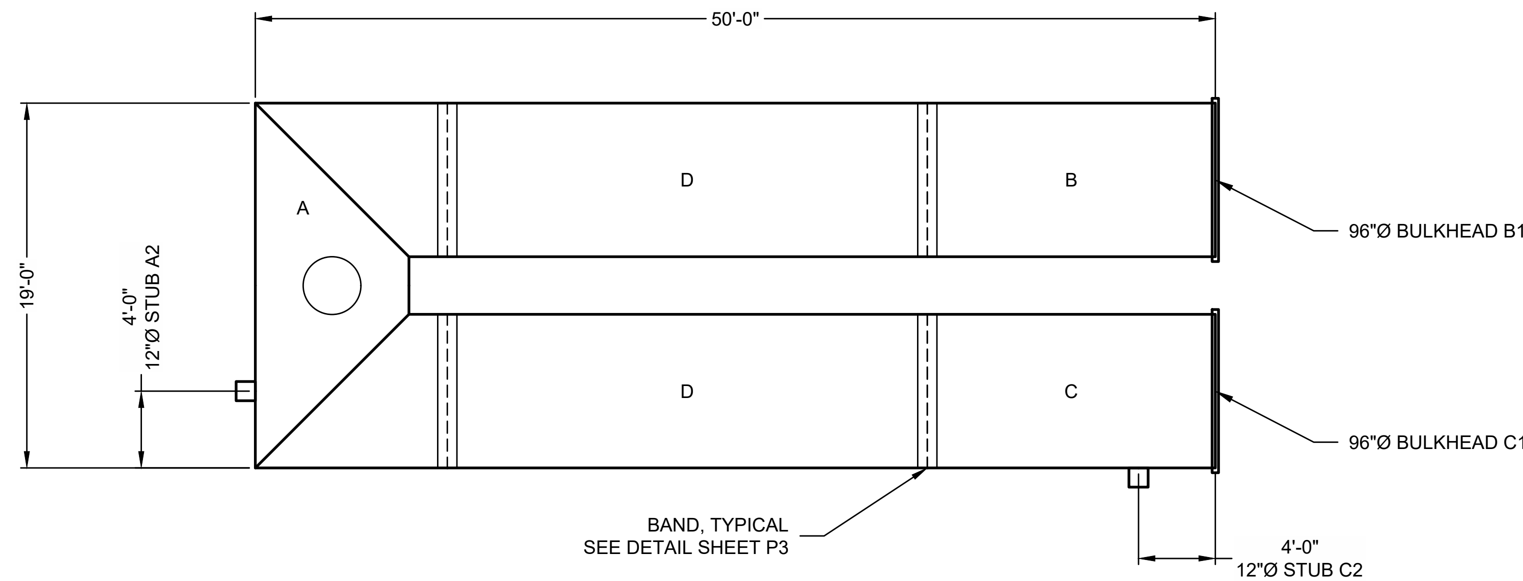
DATE: NOVEMBER 22, 2019

STUB INFORMATION

PIECE	STUB INVERT	SYSTEM INVERT
12"Ø STUB A2	TBD	TBD
12"Ø STUB C2	TBD	TBD

RISER INFORMATION

PIECE	RIM ELEV.	SYSTEM INVERT
36"Ø RISER A1	TBD	TBD



ASSEMBLY

SCALE: 1" = 10'
PIPE STORAGE: 5,178 CF
STRUCTURAL BACKFILL STORAGE: 2,126 CF
TOTAL STORAGE PROVIDED: 7,304 CF
LOADING: H20
PIPE INV. = TBD'±

NOTES

- THE PIPE SHOULD BE FULLY PERFORATED IN ACCORDANCE WITH AASHTO M 36, SECTION 8.3.2.2, AND USING CLASS 2 PERFORATIONS. THE TOTAL OPEN AREA OF THE PERFORATIONS WILL BE A MINIMUM OF 2.3% OF THE PIPE SURFACE AREA.
- BULKHEADS SHALL BE 12-GAGE OR HEAVIER STEEL AND THE COATING WILL MATCH THE SPECIFIED CMP COATING. BULKHEAD PLATES SHALL BE FULLY WELDED ONTO THE CMP WITH STEEL REINFORCEMENT AS REQUIRED. THE STEEL REINFORCEMENT SHALL BE POST COATED WITH ZINC RICH PAINT PER AASHTO M 36. BULKHEAD DESIGNS SHALL SATISFY THE REQUIREMENTS SHOWN IN CHAPTER 8 OF THE NCSPA CSP DESIGN MANUAL AND CALCULATIONS SHALL BE PROVIDED TO THE ENGINEER OF RECORD (EOR) FOR APPROVAL UPON REQUEST.
- ALL FITTINGS SHALL BE STRUCTURALLY CHECKED FOR REINFORCEMENTS PER ASTM A998 AND PROVIDED TO THE EOR FOR APPROVAL UPON REQUEST.
- CONNECTING BANDS FOR INFILTRATION SYSTEMS SHALL BE ANY TYPE, BUT MUST BE AT LEAST 12" WIDE. BANDS SHALL MATCH THE SPECIFIED CMP COATING AND MEET THE REQUIREMENTS OF AASHTO M 36.
- ALL METALLIC COATINGS AFFECTED BY MANUFACTURING FABRICATION SHALL BE REPAIRED PER AASHTO M 36 SECTION 11 REQUIREMENTS (E.G. ZINC-RICH PAINT ON ALL WELDS). IF POLYMER COATINGS ARE USED THE REPAIR OF DAMAGED COATINGS WILL BE IN CONFORMANCE WITH AASHTO M 245 SECTION 11 REQUIREMENTS.
- ACCESS LADDERS SHALL BE ATTACHED BY THE MANUFACTURER PRIOR TO DELIVERY, NOT INSTALLED ON THE JOBSITE.

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (P5) PAGES INCLUDING THE FOLLOWING:

- **PIPE STORAGE = 5,178 CF**
- **MAINLINE PIPE GAGE = 16**
- **WALL TYPE = PERFORATED**
- **DIAMETER = 96"**
- **FINISH = ALT2**
- **CORRUGATION = 5x1**

CUSTOMER ____________ DATE ____________

MARK	DATE	REVISION DESCRIPTION	BY

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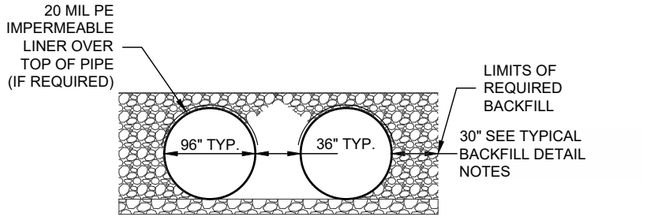
ENGINEERED SOLUTIONS LLC
www.ContechES.com
11815 NE Glenn Widing Drive, Portland, OR 97220
800-548-4667 503-240-3393 800-561-1271 FAX

CONTECH®
CMP DETENTION SYSTEMS
CONTECH
PROPOSAL
DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-010
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN A

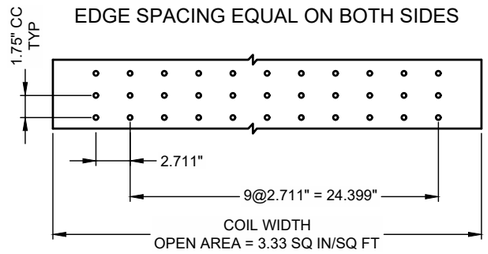
PROJECT No.: 631709	SEQ. No.: 010	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P1	OF	P4



TYPICAL SECTION VIEW

NOT TO SCALE

NOTE: IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.



NOTES:
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.
4. ALL HOLES 3/8"Ø.

EXFILTRATION AREA

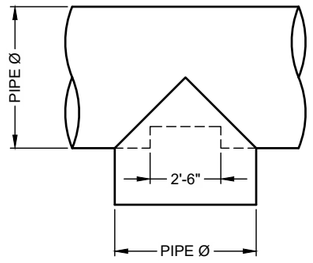
STANDARD PERFORATION PATTERNS

APPROXIMATE AREA PER LINEAR FOOT OF PIPE				
PIPE	CORRUGATION PATTERN			
	2 2/3" x 1/2"	3" x 1"	5" x 1"	ULTRA FLO
96"Ø	97.7 SQ. IN.	103.2 SQ. IN.	100.4 SQ. IN.	

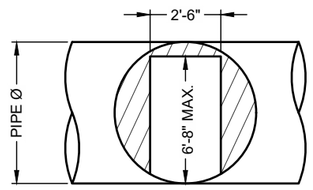
NOTES:
- GAGE AND COATING LIMITATIONS APPLY. 5" x 1" IS NOT AVAILABLE IN ALUMINUM.
- DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.

TYPICAL PERFORATION DETAIL

NOT TO SCALE



PLAN

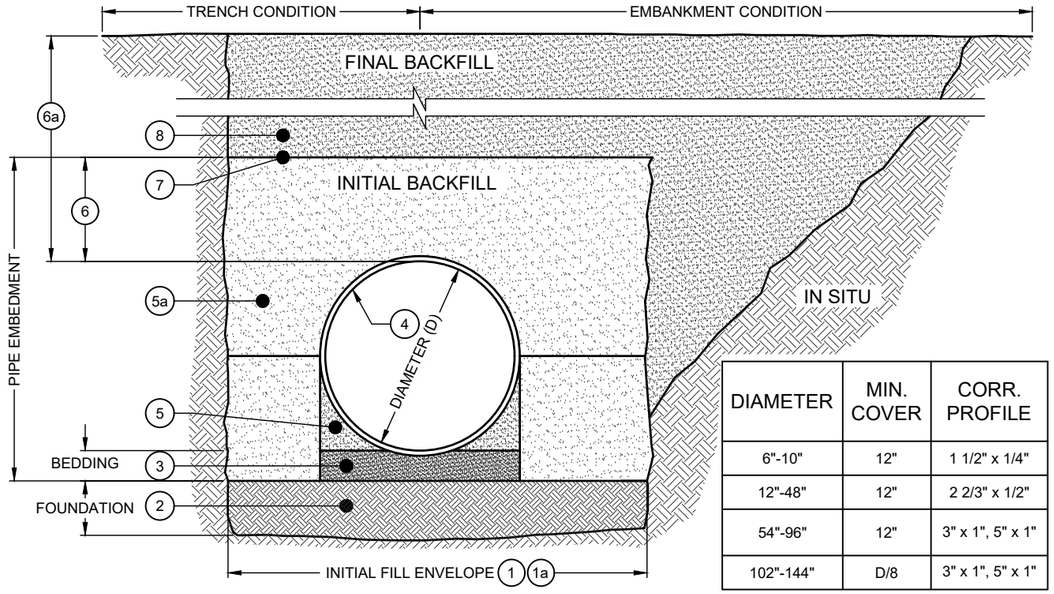


FRONT

96"Ø to 144"Ø FITTING REINFORCEMENT MAY BE REQUIRED BASED ON HEIGHT OF COVER AND LIVE LOAD CONDITION

TYPICAL MANWAY DETAIL

NOT TO SCALE



DIAMETER	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
54"-96"	12"	3" x 1", 5" x 1"
102"-144"	D/8	3" x 1", 5" x 1"

BACKFILL REQUIREMENTS FOLLOW THE GUIDELINES OF AASHTO LRFD BRIDGE DESIGN (SEC 12) AND CONSTRUCTION (SEC 26)

1 MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE MINIMUM TRENCH WIDTH (12.6.6.1):
PIPE ≤ 12": D + 16"
PIPE > 12": 1.5D + 12"

1a MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE (12.6.6.2):
PIPE < 24": 3.0D
PIPE 24" - 144": D + 4'0"
PIPE > 144": D + 10'0"

2 THE FOUNDATION UNDER THE PIPE AND SIDE BACKFILL SHALL BE ADEQUATE TO SUPPORT THE LOADS ACTING UPON IT (26.5.2).

3 BEDDING MATERIAL SHALL BE A RELATIVELY LOOSE GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, AND A MINIMUM OF TWICE THE CORRUGATION DEPTH IN THICKNESS, WITH THE MAXIMUM PARTICLE SIZE OF ONE-HALF OF THE CORRUGATION DEPTH (26.3.8.1, 26.5.3).

4 PERFORATED CORRUGATED STEEL PIPE (CSP / HEL-COR).

5 HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION (26.5.4).

5a BACKFILL MATERIAL SHALL BE A CLEAN, CRUSHED STONE MEETING SIZE NO. 3 OR 4, PER AASHTO M 43. IT IS RECOMMENDED THAT LIFTS NOT EXCEED AN 8" UNCOMPACTED LIFT HEIGHT TO PREVENT UNEVEN LOADING, AND THE LESSER OF 1/3 THE DIAMETER OR 24" AS THE MAXIMUM DIFFERENTIAL SIDE-TO-SIDE. COMPACTION OF ALL PLACED FILL MATERIAL IS NECESSARY AND SHALL BE CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE PROJECT ENGINEER, OR THEIR REPRESENTATIVE, IS SATISFIED WITH THE LEVEL OF COMPACTION (26.5.4).

6 INITIAL BACKFILL ABOVE PIPE MAY INCLUDE ROAD BASE MATERIAL (AND RIGID PAVEMENT IF APPLICABLE). SEE TABLE ABOVE.

6a TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT (12.6.6.3).

7 GEOTEXTILE SHALL BE USED TO WRAP TRENCH SIDES AND TOP ONLY TO PREVENT SOIL MIGRATION INTO VARYING SOIL TYPES (PROJECT ENGINEER).

8 FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD (26.5.4.1).

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE PIPE DIA./2 BUT NO LESS THAN 12", OR 36" FOR PIPE DIAMETERS 72" AND LARGER. CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING (TABLE C12.6.7-1).

TYPICAL BACKFILL DETAIL

NOT TO SCALE

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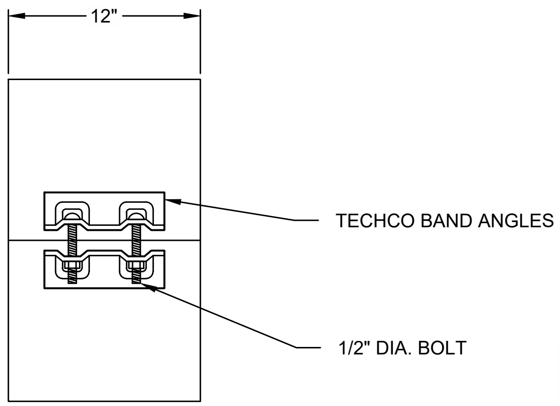
www.ContechES.com
11815 NE Glenn Widing Drive, Portland, OR 97220
800-548-4667 503-240-3393 800-561-1271 FAX

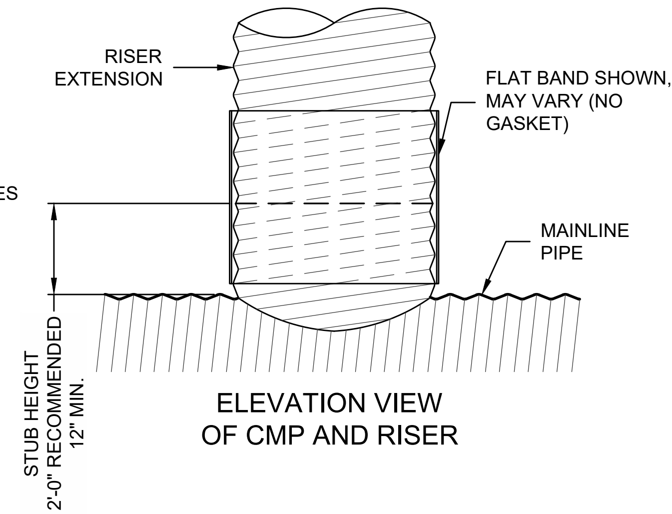
CONTECH CMP DETENTION SYSTEMS
CONTECH **PROPOSAL** DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-010
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN A

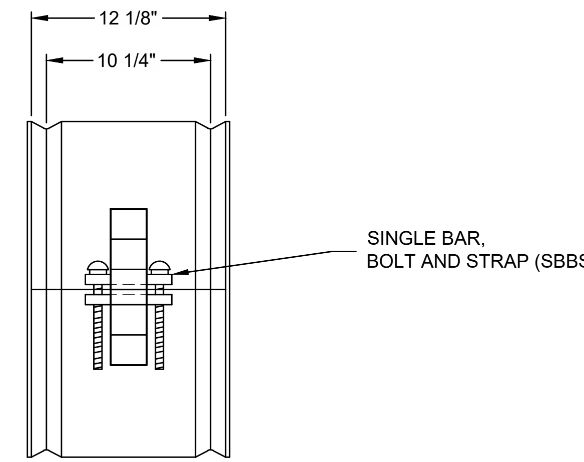
PROJECT No.:	SEQ. No.:	DATE:
631709	010	10/16/2019
DESIGNED: RLH	DRAWN: RLH	
CHECKED:	APPROVED:	
SHEET NO.: P2 OF P4		



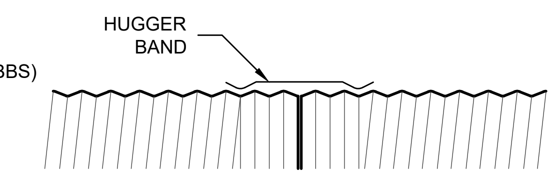
CONNECTION DETAIL
7 1/2" TECHCO SHOWN - MAY VARY



ELEVATION VIEW
OF CMP AND RISER



CONNECTION DETAIL
(SBBS)



NO GASKET

PLAIN END CMP RISER PIPE

GENERAL NOTES:

1. **DELIVERED BAND STYLE AND FASTENER TYPE MAY VARY BY FABRICATION PLANT.**
2. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
3. BAND MATERIAL AND GAGE TO BE SAME AS RISER MATERIAL.
4. IF RISER HAS A HEIGHT OF COVER OF 10' OR MORE, USE A SLIP JOINT.
5. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" 2-PIECES
6. ALL RISER JOINT COMPONENTS WILL BE FIELD ASSEMBLED.
7. MANHOLE RISERS IN APPLICATIONS WHERE TRAFFIC LOADS ARE IMPOSED REQUIRE SPECIAL DESIGN CONSIDERATIONS.
8. DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.

12" RISER BAND DETAIL

NOT TO SCALE

2 2/3"x1/2" RE-ROLLED END HEL-COR PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

H-12 HUGGER BAND DETAIL

NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS

CONTECH **PROPOSAL** DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-010
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN A

PROJECT No.: 631709	SEQ. No.: 010	DATE: 10/16/2019
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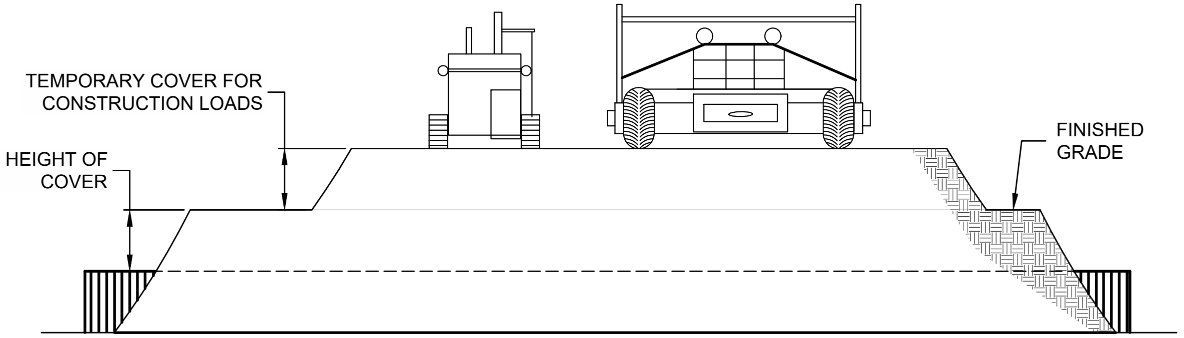
CHECKED:		APPROVED:
SHEET NO.: P3	OF	P4



CONSTRUCTION LOADS

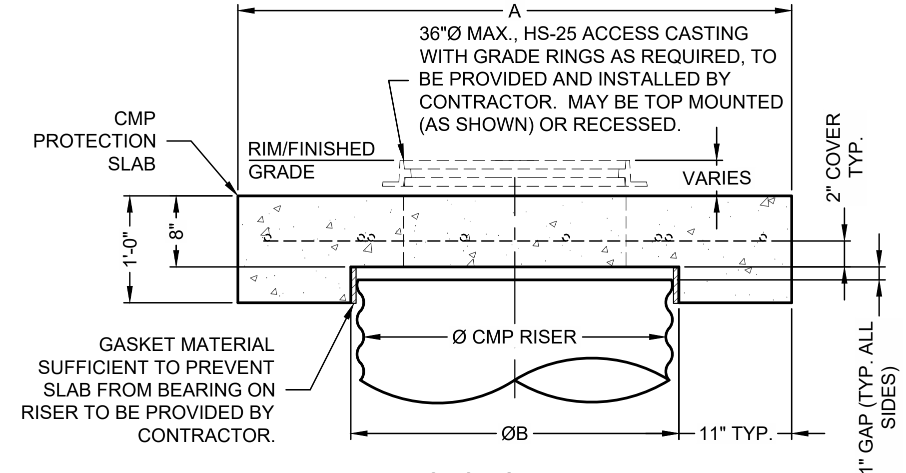
FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

NOT TO SCALE



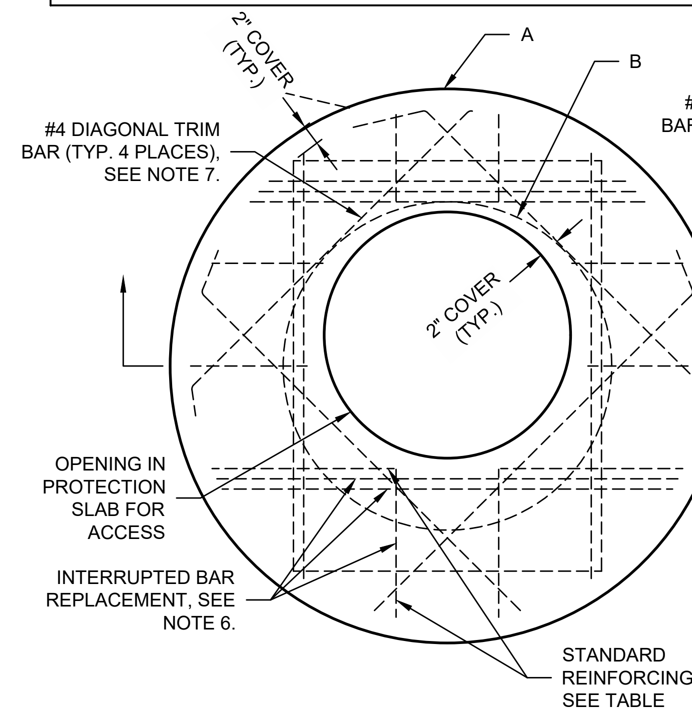
SECTION VIEW

Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

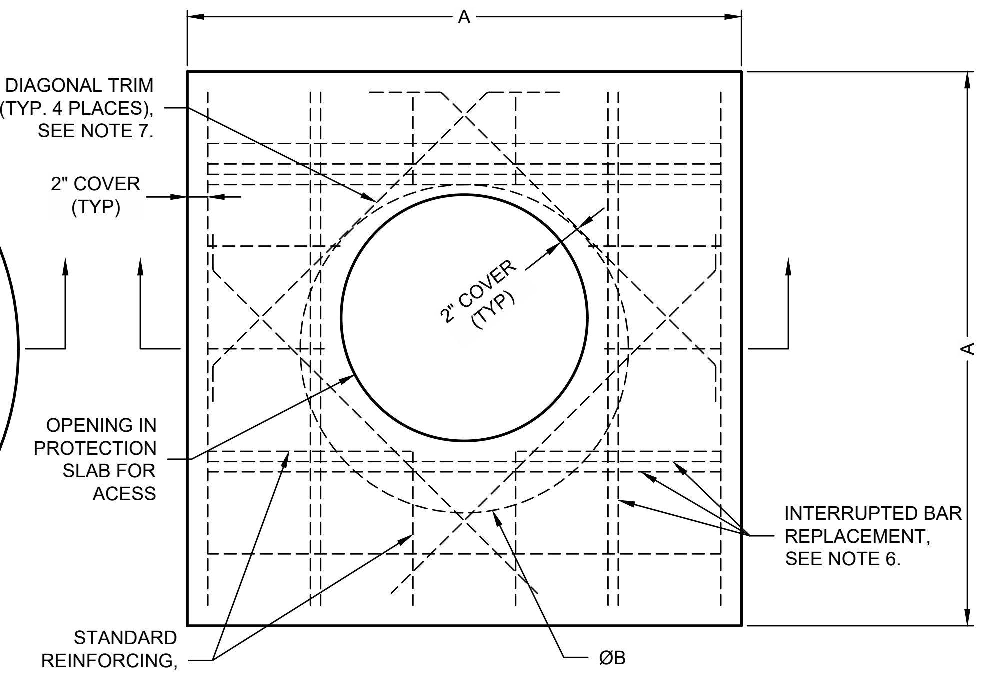
REINFORCING TABLE

** ASSUMED SOIL BEARING CAPACITY

ACCESS CASTING NOT SUPPLIED BY CONTECH



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

MANHOLE CAP DETAIL

NOT TO SCALE

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

MATERIAL SPECIFICATION

NOT TO SCALE

MARK	DATE	REVISION DESCRIPTION	BY

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CONTECH CMP DETENTION SYSTEMS

CONTECH PROPOSAL DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-010
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN A

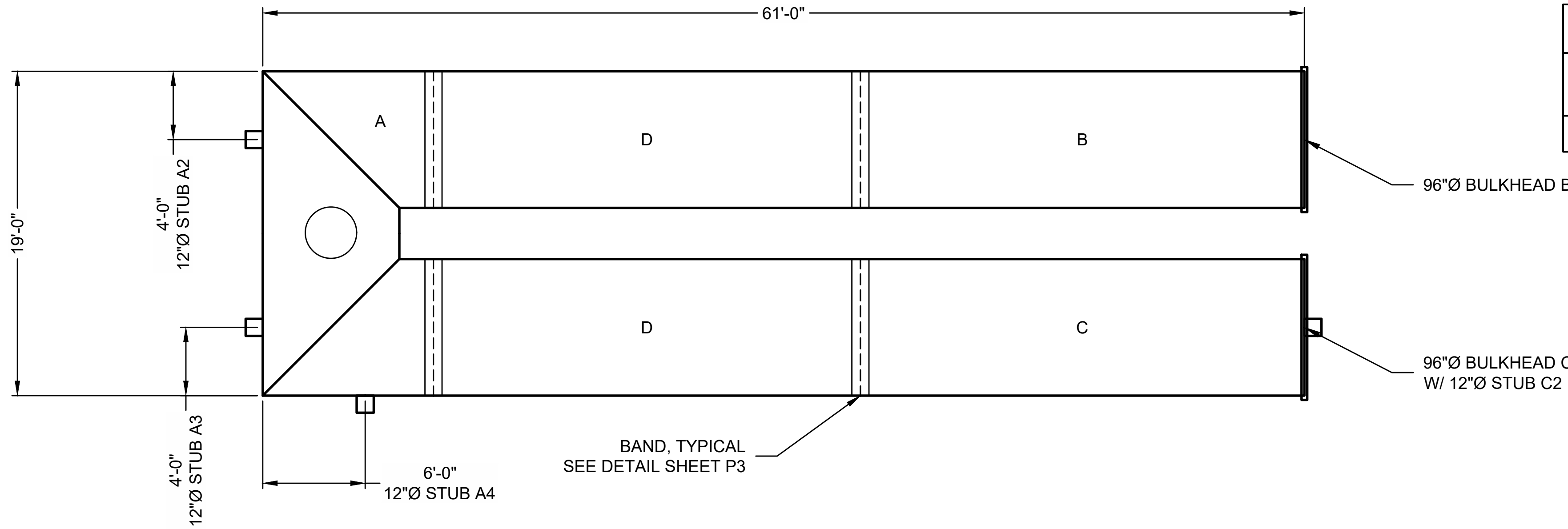
PROJECT No.:	SEQ. No.:	DATE:
631709	010	10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P4	OF	P4

STUB INFORMATION

PIECE	STUB INVERT	SYSTEM INVERT
12"Ø STUB A2	TBD	TBD
12"Ø STUB A3	TBD	TBD
12"Ø STUB A4	TBD	TBD
12"Ø STUB C2	TBD	TBD

RISER INFORMATION

PIECE	RIM ELEV.	SYSTEM INVERT
36"Ø RISER A1	TBD	TBD



NOTES

- THE PIPE SHOULD BE FULLY PERFORATED IN ACCORDANCE WITH AASHTO M 36, SECTION 8.3.2.2, AND USING CLASS 2 PERFORATIONS. THE TOTAL OPEN AREA OF THE PERFORATIONS WILL BE A MINIMUM OF 2.3% OF THE PIPE SURFACE AREA.
- BULKHEADS SHALL BE 12-GAGE OR HEAVIER STEEL AND THE COATING WILL MATCH THE SPECIFIED CMP COATING. BULKHEAD PLATES SHALL BE FULLY WELDED ONTO THE CMP WITH STEEL REINFORCEMENT AS REQUIRED. THE STEEL REINFORCEMENT SHALL BE POST COATED WITH ZINC RICH PAINT PER AASHTO M 36. BULKHEAD DESIGNS SHALL SATISFY THE REQUIREMENTS SHOWN IN CHAPTER 8 OF THE NCSPA CSP DESIGN MANUAL AND CALCULATIONS SHALL BE PROVIDED TO THE ENGINEER OF RECORD (EOR) FOR APPROVAL UPON REQUEST.
- ALL FITTINGS SHALL BE STRUCTURALLY CHECKED FOR REINFORCEMENTS PER ASTM A998 AND PROVIDED TO THE EOR FOR APPROVAL UPON REQUEST.
- CONNECTING BANDS FOR INFILTRATION SYSTEMS SHALL BE ANY TYPE, BUT MUST BE AT LEAST 12" WIDE. BANDS SHALL MATCH THE SPECIFIED CMP COATING AND MEET THE REQUIREMENTS OF AASHTO M 36.
- ALL METALLIC COATINGS AFFECTED BY MANUFACTURING FABRICATION SHALL BE REPAIRED PER AASHTO M 36 SECTION 11 REQUIREMENTS (E.G. ZINC-RICH PAINT ON ALL WELDS). IF POLYMER COATINGS ARE USED THE REPAIR OF DAMAGED COATINGS WILL BE IN CONFORMANCE WITH AASHTO M 245 SECTION 11 REQUIREMENTS.
- ACCESS LADDERS SHALL BE ATTACHED BY THE MANUFACTURER PRIOR TO DELIVERY, NOT INSTALLED ON THE JOBSITE.

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (P4) PAGES INCLUDING THE FOLLOWING:

- **PIPE STORAGE = 6,284 CF**
- **MAINLINE PIPE GAGE = 16**
- **WALL TYPE = PERFORATED**
- **DIAMETER = 96"**
- **FINISH = ALT2**
- **CORRUGATION = 5x1**

CUSTOMER ____________ DATE ____________

ASSEMBLY

SCALE: 1" = 10'
PIPE STORAGE: 6,284 CF
STRUCTURAL BACKFILL STORAGE: 2,555 CF
TOTAL STORAGE PROVIDED: 8,839 CF
LOADING: H20
PIPE INV. = TBD'±

MARK	DATE	REVISION DESCRIPTION	BY

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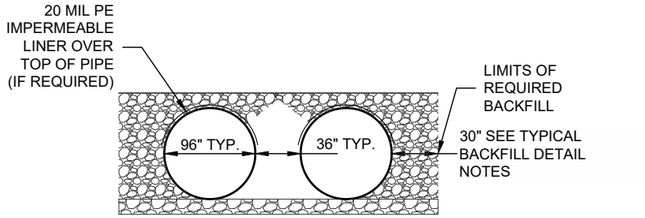
CONTECH CMP DETENTION SYSTEMS

CONTECH PROPOSAL DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-020
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN B

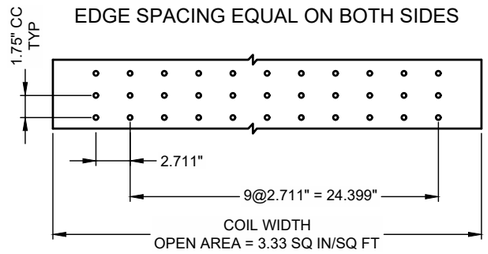
PROJECT No.: 631709	SEQ. No.: 020	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P1	OF	P4



TYPICAL SECTION VIEW

NOT TO SCALE

NOTE: IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.



NOTES:
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.
4. ALL HOLES 3/8"Ø.

EXFILTRATION AREA

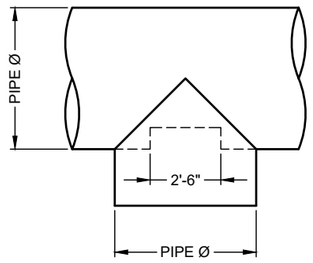
STANDARD PERFORATION PATTERNS

APPROXIMATE AREA PER LINEAR FOOT OF PIPE				
PIPE	CORRUGATION PATTERN			
	2 2/3" x 1/2"	3" x 1"	5" x 1"	ULTRA FLO
96"Ø	97.7 SQ. IN.	103.2 SQ. IN.	100.4 SQ. IN.	

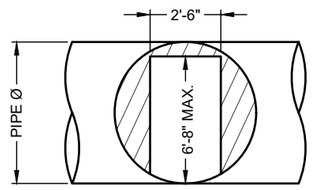
NOTES:
- GAGE AND COATING LIMITATIONS APPLY. 5" x 1" IS NOT AVAILABLE IN ALUMINUM.
- DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.

TYPICAL PERFORATION DETAIL

NOT TO SCALE



PLAN

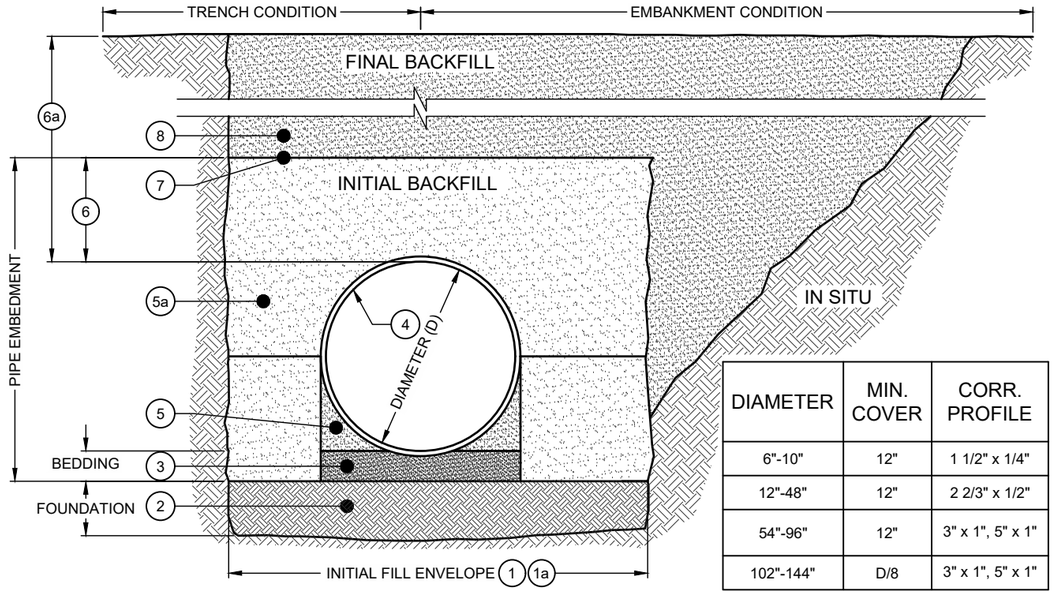


FRONT

96"Ø to 144"Ø FITTING REINFORCEMENT MAY BE REQUIRED BASED ON HEIGHT OF COVER AND LIVE LOAD CONDITION

TYPICAL MANWAY DETAIL

NOT TO SCALE



DIAMETER	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
54"-96"	12"	3" x 1", 5" x 1"
102"-144"	D/8	3" x 1", 5" x 1"

BACKFILL REQUIREMENTS FOLLOW THE GUIDELINES OF AASHTO LRFD BRIDGE DESIGN (SEC 12) AND CONSTRUCTION (SEC 26)

1 MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE.
THE MINIMUM TRENCH WIDTH (12.6.6.1):
PIPE ≤ 12": D + 16"
PIPE > 12": 1.5D + 12"

1a MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE (12.6.6.2):
PIPE < 24": 3.0D
PIPE 24" - 144": D + 4'0"
PIPE > 144": D + 10'0"

2 THE FOUNDATION UNDER THE PIPE AND SIDE BACKFILL SHALL BE ADEQUATE TO SUPPORT THE LOADS ACTING UPON IT (26.5.2).

3 BEDDING MATERIAL SHALL BE A RELATIVELY LOOSE GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, AND A MINIMUM OF TWICE THE CORRUGATION DEPTH IN THICKNESS, WITH THE MAXIMUM PARTICLE SIZE OF ONE-HALF OF THE CORRUGATION DEPTH (26.3.8.1, 26.5.3).

4 PERFORATED CORRUGATED STEEL PIPE (CSP / HEL-COR).

5 HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION (26.5.4).

5a BACKFILL MATERIAL SHALL BE A CLEAN, CRUSHED STONE MEETING SIZE NO. 3 OR 4, PER AASHTO M 43. IT IS RECOMMENDED THAT LIFTS NOT EXCEED AN 8" UNCOMPACTED LIFT HEIGHT TO PREVENT UNEVEN LOADING, AND THE LESSER OF 1/3 THE DIAMETER OR 24" AS THE MAXIMUM DIFFERENTIAL SIDE-TO-SIDE. COMPACTION OF ALL PLACED FILL MATERIAL IS NECESSARY AND SHALL BE CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE PROJECT ENGINEER, OR THEIR REPRESENTATIVE, IS SATISFIED WITH THE LEVEL OF COMPACTION (26.5.4).

6 INITIAL BACKFILL ABOVE PIPE MAY INCLUDE ROAD BASE MATERIAL (AND RIGID PAVEMENT IF APPLICABLE). SEE TABLE ABOVE.

6a TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT (12.6.6.3).

7 GEOTEXTILE SHALL BE USED TO WRAP TRENCH SIDES AND TOP ONLY TO PREVENT SOIL MIGRATION INTO VARYING SOIL TYPES (PROJECT ENGINEER).

8 FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD (26.5.4.1).

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE PIPE DIA./2 BUT NO LESS THAN 12", OR 36" FOR PIPE DIAMETERS 72" AND LARGER. CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING (TABLE C12.6.7-1).

TYPICAL BACKFILL DETAIL

NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH **PROPOSAL** DRAWING

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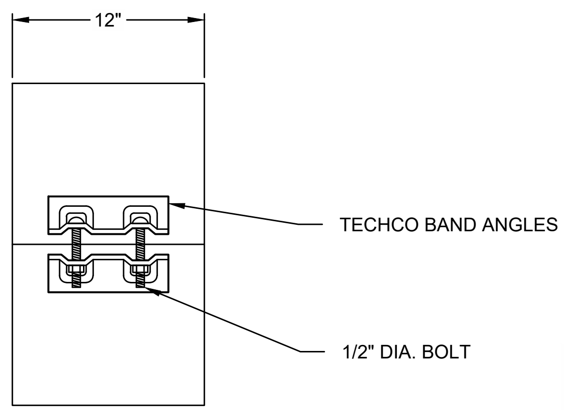
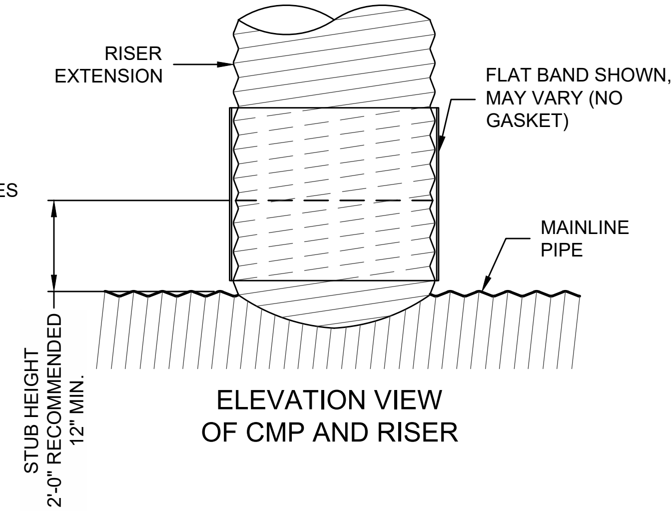
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN B

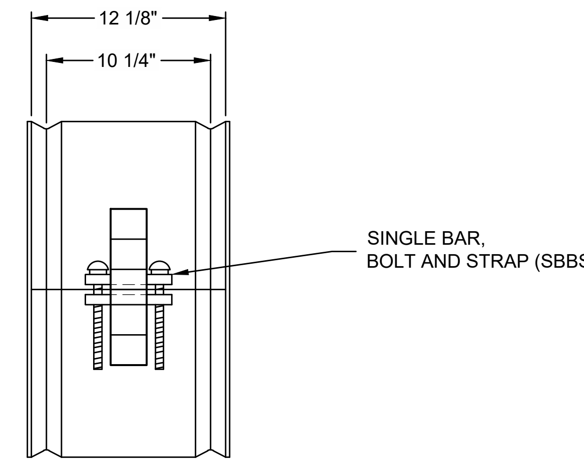
PROJECT No.:	SEQ. No.:	DATE:
631709	020	10/16/2019
DESIGNED: RLH	DRAWN: RLH	
CHECKED:	APPROVED:	
SHEET NO.: P2 OF P4		

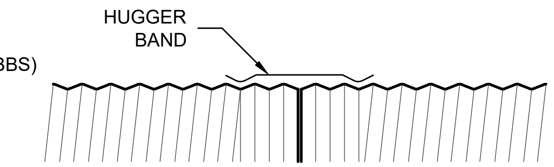


CONNECTION DETAIL
7 1/2" TECHCO SHOWN - MAY VARY



ELEVATION VIEW
OF CMP AND RISER





NO GASKET

CONNECTION DETAIL
(SBBS)

PLAIN END CMP RISER PIPE

GENERAL NOTES:

1. **DELIVERED BAND STYLE AND FASTENER TYPE MAY VARY BY FABRICATION PLANT.**
2. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
3. BAND MATERIAL AND GAGE TO BE SAME AS RISER MATERIAL.
4. IF RISER HAS A HEIGHT OF COVER OF 10' OR MORE, USE A SLIP JOINT.
5. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" 2-PIECES
6. ALL RISER JOINT COMPONENTS WILL BE FIELD ASSEMBLED.
7. MANHOLE RISERS IN APPLICATIONS WHERE TRAFFIC LOADS ARE IMPOSED REQUIRE SPECIAL DESIGN CONSIDERATIONS.
8. DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.

12" RISER BAND DETAIL
NOT TO SCALE

2 2/3"x1/2" RE-ROLLED END HEL-COR PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

H-12 HUGGER BAND DETAIL
NOT TO SCALE

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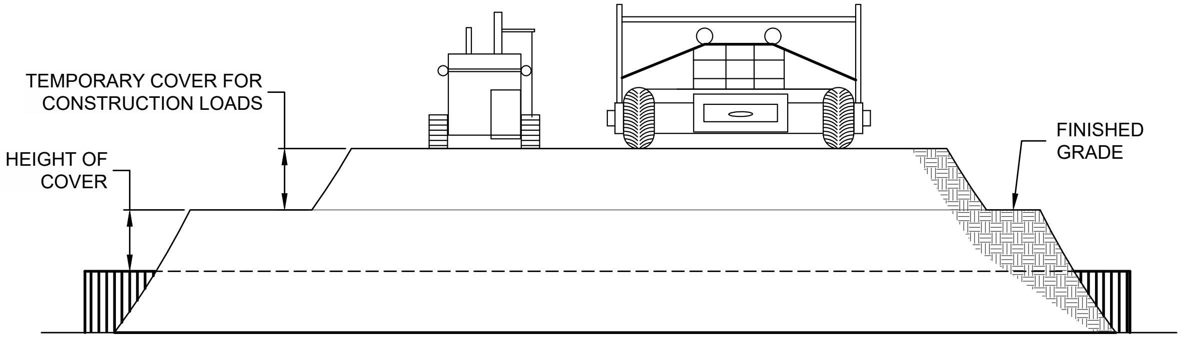
CONTECH CMP DETENTION SYSTEMS

CONTECH **PROPOSAL** DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-020
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN B

PROJECT No.: 631709	SEQ. No.: 020	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P3 OF P4		



CONSTRUCTION LOADS

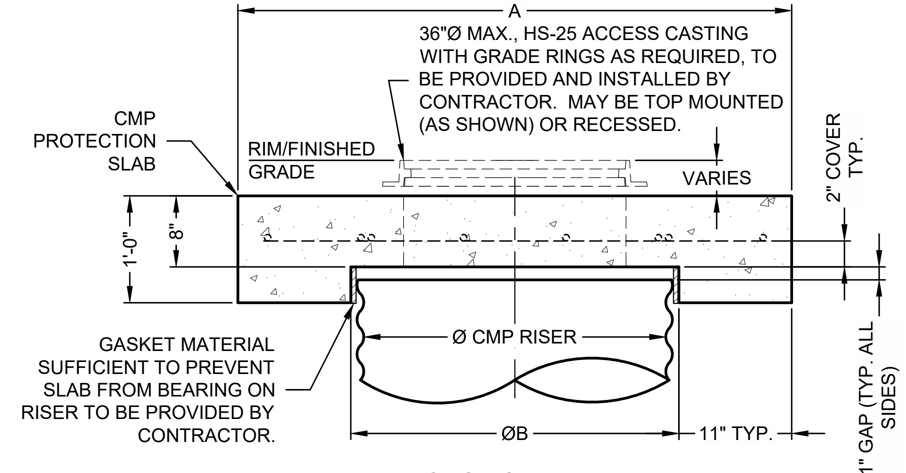
FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

NOT TO SCALE



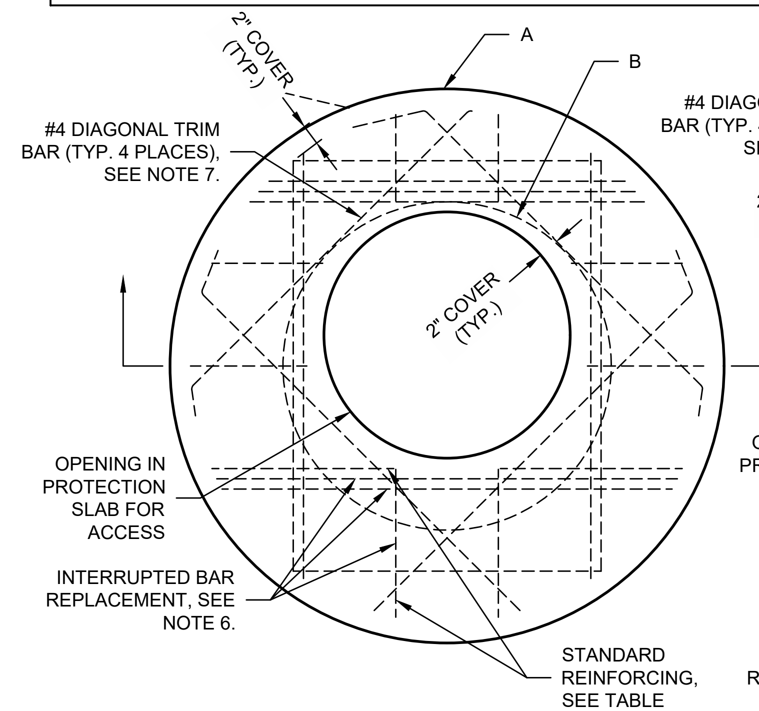
SECTION VIEW

REINFORCING TABLE

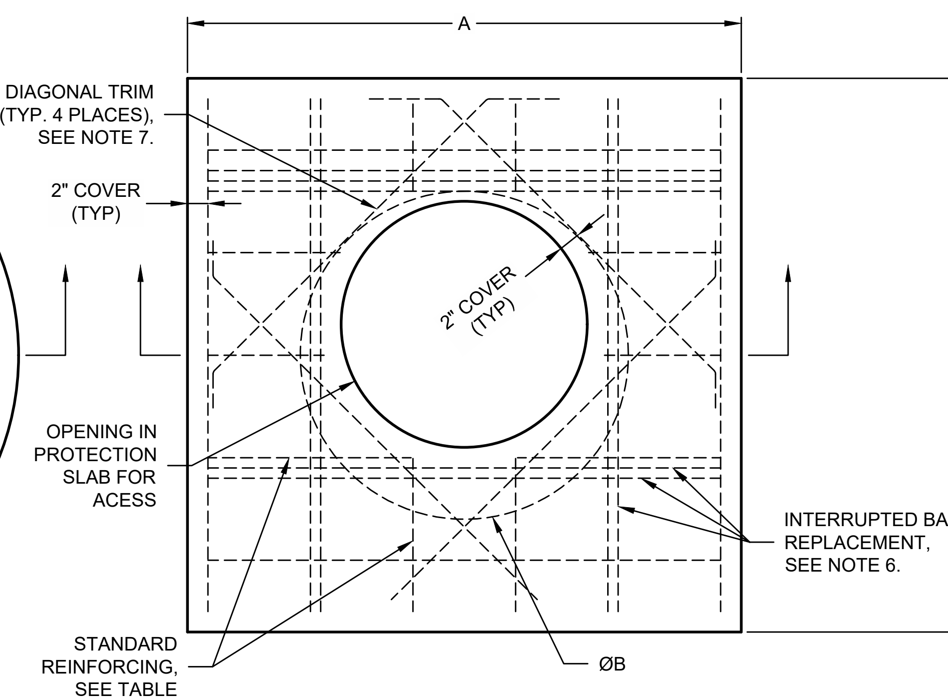
Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

** ASSUMED SOIL BEARING CAPACITY

ACCESS CASTING NOT SUPPLIED BY CONTECH



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

MATERIAL SPECIFICATION

NOT TO SCALE

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

MANHOLE CAP DETAIL

NOT TO SCALE

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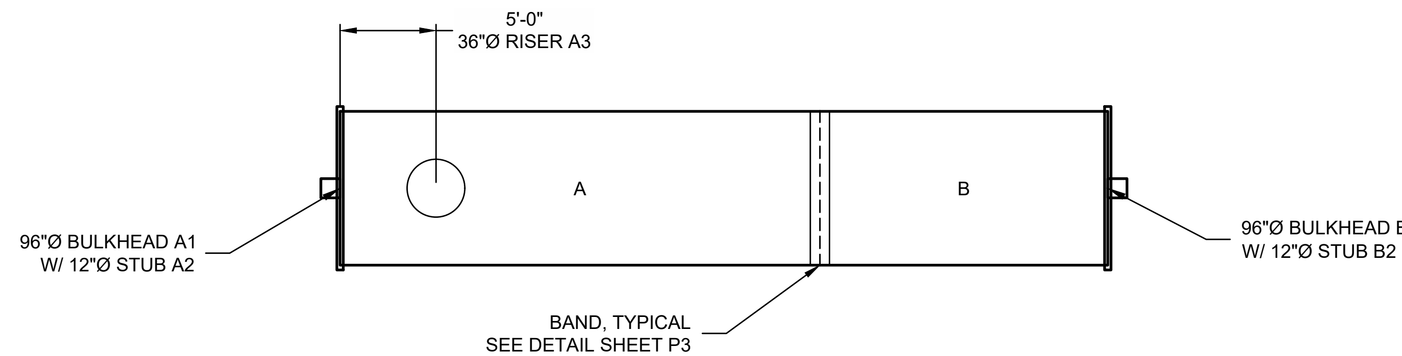
631709	020	10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P4 OF P4		

STUB INFORMATION		
PIECE	STUB INVERT	SYSTEM INVERT
12"Ø STUB A2	TBD	TBD
12"Ø STUB B2	TBD	TBD

RISER INFORMATION		
PIECE	RIM ELEV.	SYSTEM INVERT
36"Ø RISER A3	TBD	TBD



ASSEMBLY

SCALE: 1" = 10'
PIPE STORAGE: 2,011 CF
STRUCTURAL BACKFILL STORAGE: 1,096 CF
TOTAL STORAGE PROVIDED: 3,107 CF
LOADING: H20
PIPE INV. = TBD'±

NOTES

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- **MAINLINE PIPE GAGE = 16**
- **WALL TYPE = PERFORATED**
- **DIAMETER = 96"**
- **FINISH = ALT2**
- **CORRUGATION = 5x1**

CUSTOMER _______________ DATE _______________

MARK	DATE	REVISION DESCRIPTION	BY

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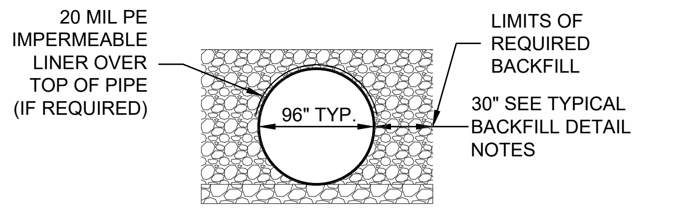
CONTECH® CMP DETENTION SYSTEMS

CONTECH **PROPOSAL** DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-030
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN C

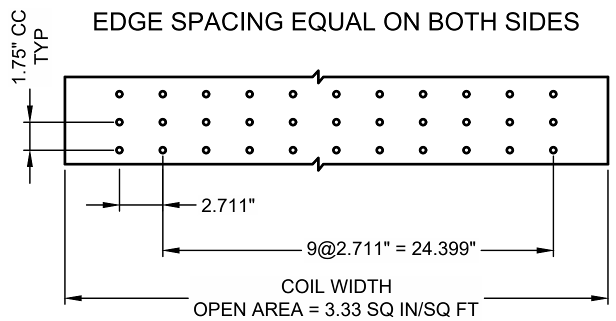
PROJECT No.: 631709	SEQ. No.: 030	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P1 OF P4		



TYPICAL SECTION VIEW

NOT TO SCALE

NOTE: IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.



NOTES:
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.
4. ALL HOLES 3/8"Ø.

EXFILTRATION AREA

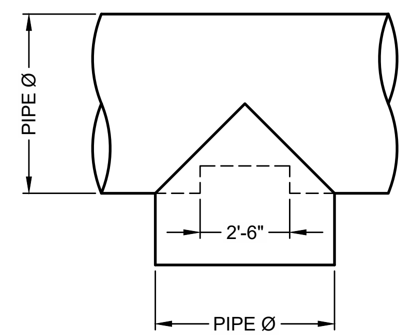
STANDARD PERFORATION PATTERNS

APPROXIMATE AREA PER LINEAR FOOT OF PIPE				
PIPE	CORRUGATION PATTERN			
	2 2/3" x 1/2"	3" x 1"	5" x 1"	ULTRA FLO
96"Ø	97.7 SQ. IN.	103.2 SQ. IN.	100.4 SQ. IN.	

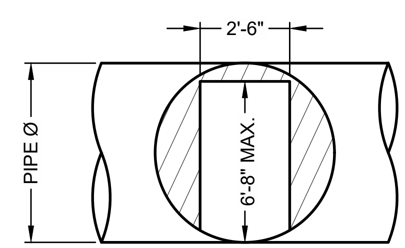
NOTES:
- GAGE AND COATING LIMITATIONS APPLY. 5" x 1" IS NOT AVAILABLE IN ALUMINUM.
- DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.

TYPICAL PERFORATION DETAIL

NOT TO SCALE



PLAN

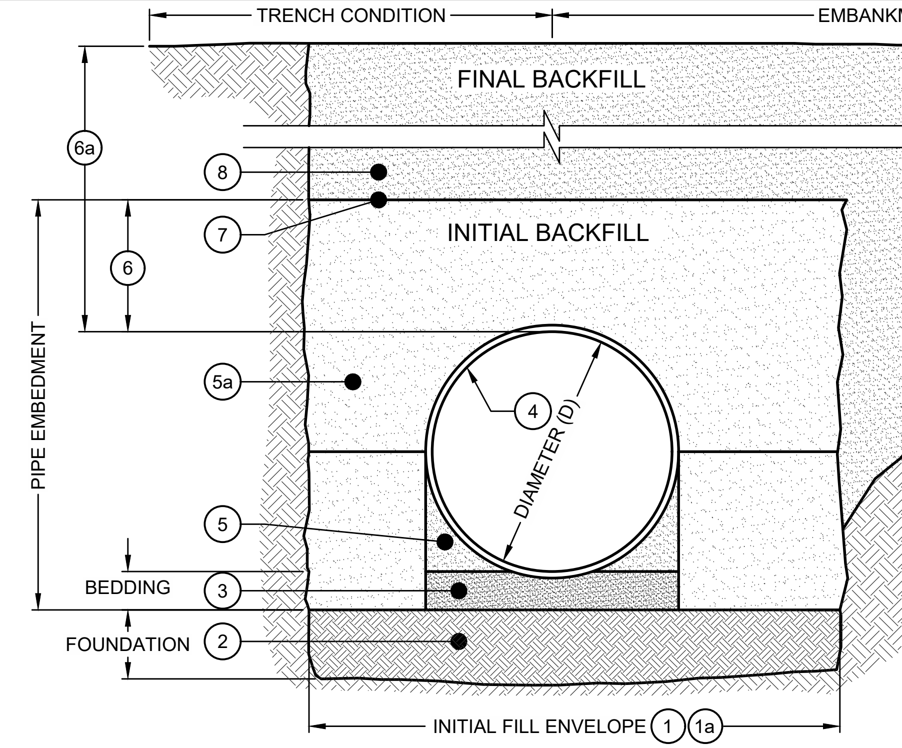


FRONT

96"Ø to 144"Ø FITTING REINFORCEMENT MAY BE REQUIRED BASED ON HEIGHT OF COVER AND LIVE LOAD CONDITION

TYPICAL MANWAY DETAIL

NOT TO SCALE



DIAMETER	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
54"-96"	12"	3" x 1", 5" x 1"
102"-144"	D/8	3" x 1", 5" x 1"

BACKFILL REQUIREMENTS FOLLOW THE GUIDELINES OF AASHTO LRFD BRIDGE DESIGN (SEC 12) AND CONSTRUCTION (SEC 26)

1 MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE MINIMUM TRENCH WIDTH (12.6.6.1):
PIPE ≤ 12": D + 16"
PIPE > 12": 1.5D + 12"

1a MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE (12.6.6.2):
PIPE < 24": 3.0D
PIPE 24" - 144": D + 4'0"
PIPE > 144": D + 10'0"

2 THE FOUNDATION UNDER THE PIPE AND SIDE BACKFILL SHALL BE ADEQUATE TO SUPPORT THE LOADS ACTING UPON IT (26.5.2).

3 BEDDING MATERIAL SHALL BE A RELATIVELY LOOSE GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, AND A MINIMUM OF TWICE THE CORRUGATION DEPTH IN THICKNESS, WITH THE MAXIMUM PARTICLE SIZE OF ONE-HALF OF THE CORRUGATION DEPTH (26.3.8.1, 26.5.3).

4 PERFORATED CORRUGATED STEEL PIPE (CSP / HEL-COR).

5 HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION (26.5.4).

5a BACKFILL MATERIAL SHALL BE A CLEAN, CRUSHED STONE MEETING SIZE NO. 3 OR 4, PER AASHTO M 43. IT IS RECOMMENDED THAT LIFTS NOT EXCEED AN 8" UNCOMPACTED LIFT HEIGHT TO PREVENT UNEVEN LOADING, AND THE LESSER OF 1/3 THE DIAMETER OR 24" AS THE MAXIMUM DIFFERENTIAL SIDE-TO-SIDE. COMPACTION OF ALL PLACED FILL MATERIAL IS NECESSARY AND SHALL BE CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE PROJECT ENGINEER, OR THEIR REPRESENTATIVE, IS SATISFIED WITH THE LEVEL OF COMPACTION (26.5.4).

6 INITIAL BACKFILL ABOVE PIPE MAY INCLUDE ROAD BASE MATERIAL (AND RIGID PAVEMENT IF APPLICABLE). SEE TABLE ABOVE.

6a TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT (12.6.6.3).

7 GEOTEXTILE SHALL BE USED TO WRAP TRENCH SIDES AND TOP ONLY TO PREVENT SOIL MIGRATION INTO VARYING SOIL TYPES (PROJECT ENGINEER).

8 FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD (26.5.4.1).

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE PIPE DIA./2 BUT NO LESS THAN 12", OR 36" FOR PIPE DIAMETERS 72" AND LARGER. CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING (TABLE C12.6.7-1).

TYPICAL BACKFILL DETAIL

NOT TO SCALE

MARK	DATE	REVISION DESCRIPTION	BY

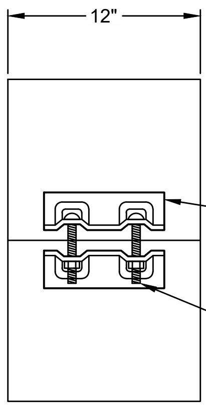
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
11815 NE Glenn Widing Drive, Portland, OR 97220
800-548-4667 503-240-3393 800-561-1271 FAX

CONTECH CMP DETENTION SYSTEMS

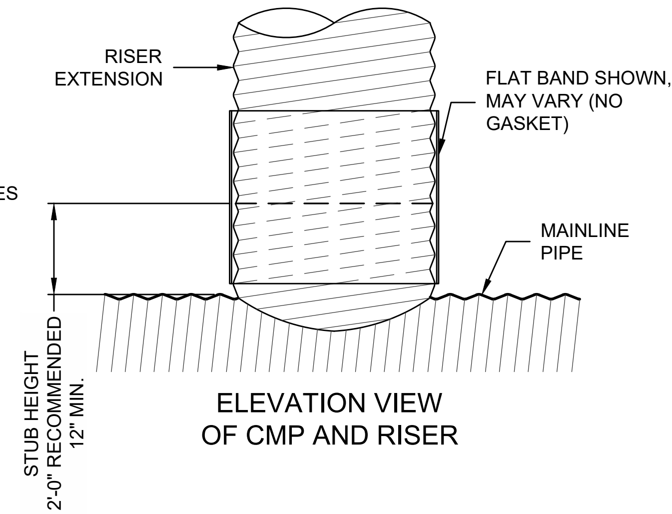
CONTECH PROPOSAL DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-030
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN C

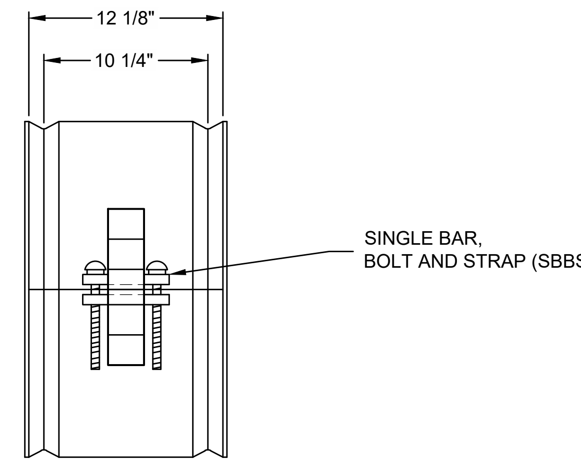
PROJECT No.: 631709	SEQ. No.: 030	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P2	OF	P4



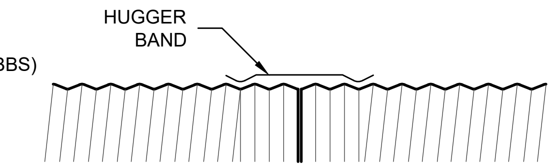
CONNECTION DETAIL
7 1/2" TECHCO SHOWN - MAY VARY



ELEVATION VIEW
OF CMP AND RISER



CONNECTION DETAIL
(SBBS)



NO GASKET

PLAIN END CMP RISER PIPE

GENERAL NOTES:

1. **DELIVERED BAND STYLE AND FASTENER TYPE MAY VARY BY FABRICATION PLANT.**
2. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
3. BAND MATERIAL AND GAGE TO BE SAME AS RISER MATERIAL.
4. IF RISER HAS A HEIGHT OF COVER OF 10' OR MORE, USE A SLIP JOINT.
5. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" 2-PIECES
6. ALL RISER JOINT COMPONENTS WILL BE FIELD ASSEMBLED.
7. MANHOLE RISERS IN APPLICATIONS WHERE TRAFFIC LOADS ARE IMPOSED REQUIRE SPECIAL DESIGN CONSIDERATIONS.
8. DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.

12" RISER BAND DETAIL

NOT TO SCALE

2 2/3"x1/2" RE-ROLLED END HEL-COR PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

H-12 HUGGER BAND DETAIL

NOT TO SCALE

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11815 NE Glenn Widing Drive, Portland, OR 97220
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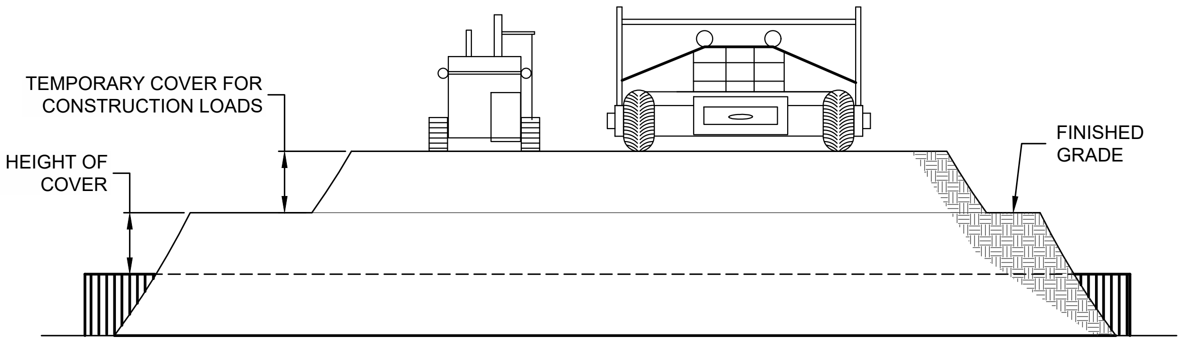
CONTECH CMP DETENTION SYSTEMS

CONTECH
PROPOSAL
DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM -
631709-030
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN C

PROJECT No.: 631709	SEQ. No.: 030	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P3	OF	P4



CONSTRUCTION LOADS

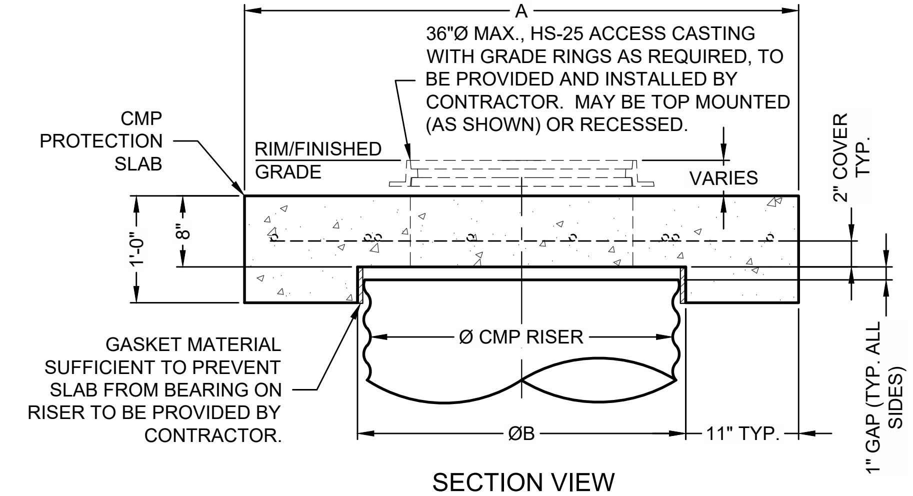
FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

NOT TO SCALE



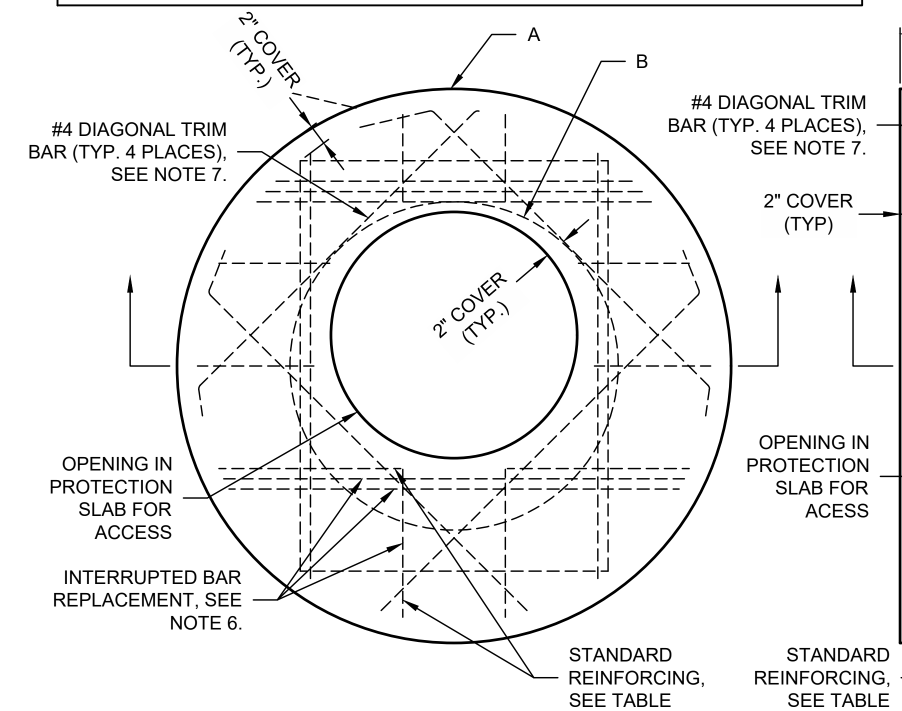
SECTION VIEW

ACCESS CASTING NOT SUPPLIED BY CONTECH

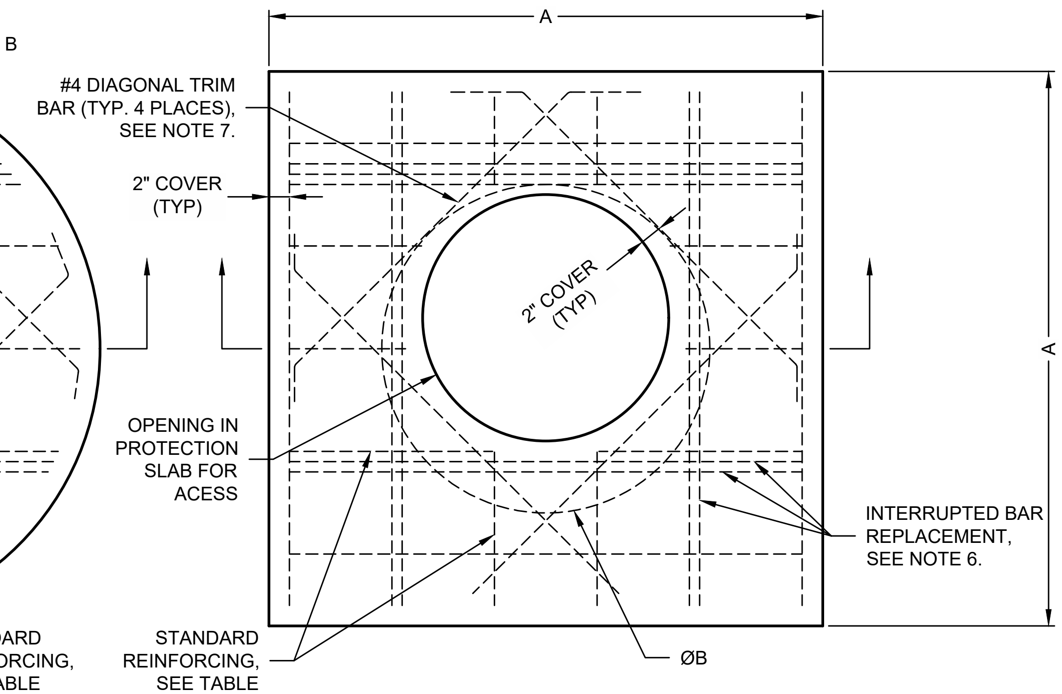
Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

REINFORCING TABLE

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

MANHOLE CAP DETAIL

NOT TO SCALE

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

MATERIAL SPECIFICATION

NOT TO SCALE

MARK	DATE	REVISION DESCRIPTION	BY

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www.ContechES.com
11815 NE Glenn Widing Drive, Portland, OR 97220
800-548-4667 503-240-3393 800-561-1271 FAX

CONTECH CMP DETENTION SYSTEMS

CONTECH PROPOSAL DRAWING

96"Ø PERFORATED UNDERGROUND RETENTION SYSTEM - 631709-030
TENTATIVE TRACT MAP NO. 82315
COVINA, CA
SITE DESIGNATION: BASIN C

PROJECT No.: 631709	SEQ. No.: 030	DATE: 10/16/2019
DESIGNED: RLH		DRAWN: RLH
CHECKED:		APPROVED:
SHEET NO.: P4	OF	P4

Attachment G

BMP Fact Sheets

S-1: Storm Drain Message and Signage

Purpose

Waste material dumped into storm drain inlets can adversely impact surface and ground waters. In fact, any material discharged into the storm drain system has the potential to significantly impact downstream receiving waters. Storm drain messages have become a popular method of alerting and reminding the public about the effects of and the prohibitions against waste disposal into the storm drain system. The signs are typically stenciled or affixed near the storm drain inlet or catch basin. The message simply informs the public that dumping of wastes into storm drain inlets is prohibited and/or that the drain ultimately discharges into receiving waters.

General Guidance

- The signs must be placed so they are easily visible to the public.
- Be aware that signs placed on sidewalk will be worn by foot traffic.

Design Specifications

- Signs with language and/or graphical icons that prohibit illegal dumping, must be posted at designated public access points along channels and streams within the project area. Consult with Los Angeles County Department of Public Works (LACDPW) staff to determine specific signage requirements for channels and streams.
- Storm drain message markers, placards, concrete stamps, or stenciled language/icons (e.g., “No Dumping – Drains to the Ocean”) are required at all storm drain inlets and catch basins within the project area to discourage illegal or inadvertent dumping. Signs should be placed in clear sight facing anyone approaching the storm drain inlet or catch basin from either side (see Figure D-1 and Figure D-2). LACDPW staff should be contacted to determine specific requirements for types of signs and methods of application. A stencil can be purchased for a nominal fee from LACDPW Building and Safety Office by calling (626) 458-3171. All storm drain inlet and catch basin locations must be identified on the project site map.

Maintenance Requirements

Legibility and visibility of markers and signs should be maintained (e.g., signs should be repainted or replaced as necessary). If required by LACDPW, the owner/operator or homeowner’s association shall enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards and signs.

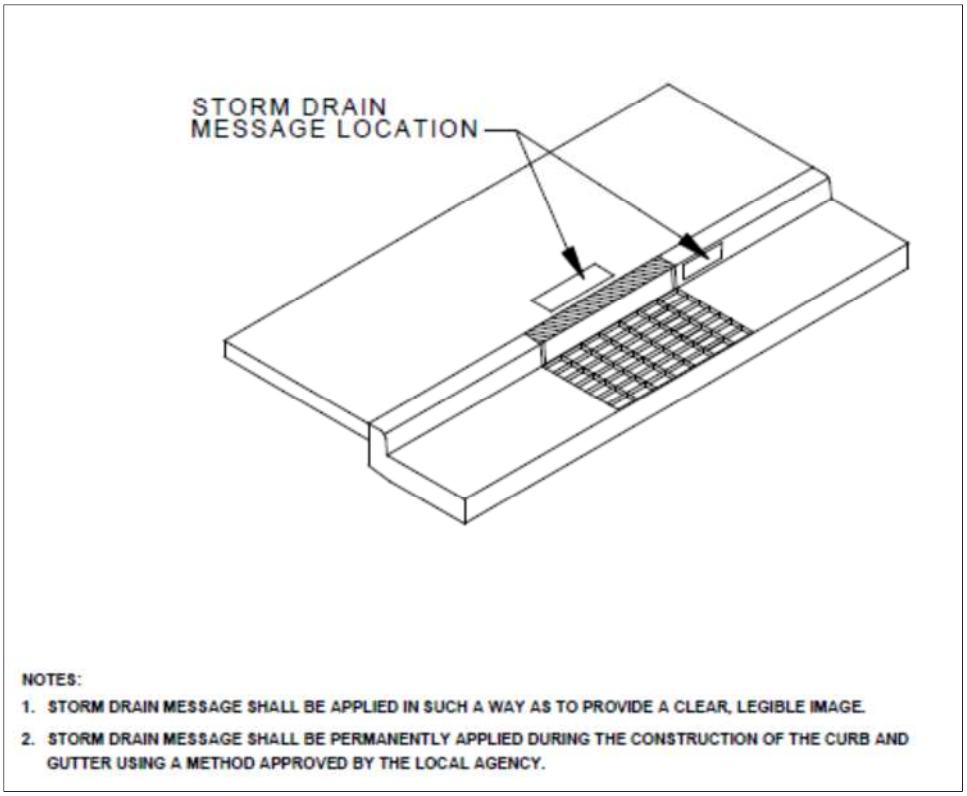

Figure D-1. Storm Drain Message Location – Curb Type Inlet

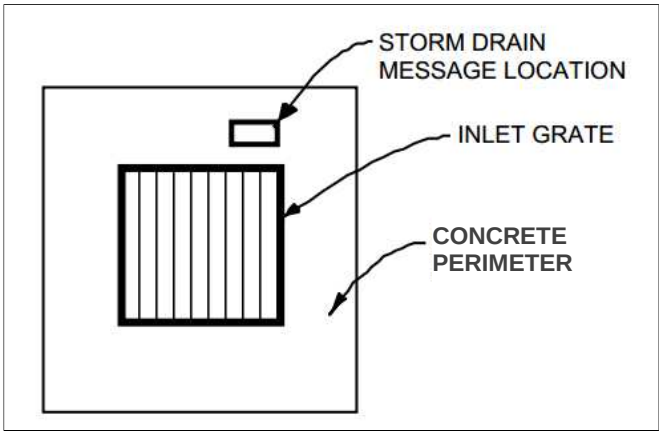

Figure D-2. Storm Drain Message Location – Catch Basin/Area Type Inlet

S-2: Outdoor Material Storage Area

Purpose

The County defines outdoor material storage areas as areas or facilities whose sole purpose is the storage of materials. Materials, including raw materials, by-products, finished products, and waste products, stored outdoors can become sources of pollutants in stormwater runoff if not handled or stored properly. The type of pollutants associated with the materials will vary depending on the type of commercial or industrial activity present.

Materials may be stored in a variety of ways, including bulk piles, containers, shelving, stacking, and tanks. Contamination of stormwater runoff may be prevented by eliminating the possibility of stormwater runoff contact with the material storage areas either through diversion, cover, or capture of the stormwater runoff. Design considerations may also include minimizing the storage area. The source control measures presented in this fact sheet must meet local permitting requirements.

Some materials, such as those containing heavy metals or toxic compounds, are of more concern than other materials. Toxic and hazardous materials must be prevented from coming in contact with stormwater runoff. Non-toxic or non-hazardous materials, such as debris and sediment, can also have significant impacts on receiving waters. Contact between non-toxic or non-hazardous materials and stormwater runoff should be limited, and such materials prevented from being discharged with stormwater runoff.

Materials are classified into three categories based on the potential risk of pollutant release associated with stormwater runoff contact – high risk, medium risk, and low risk. General types of materials under each category are presented in Table D-1. The categorization of the potential pollutant risk is used to determine the design specifications, which are presented in Table D-2, for design features at the project site.

Table D-1. Classification of Materials for Potential Pollutant Risk

High Risk Materials	Medium Risk Materials	Low Risk Materials
• Recycled materials with discharge potential • Corrosives • Food items • Chalk/gypsum products • Scrap or salvage goods • Feedstock/grain • Fertilizers • Pesticides • Compost • Asphalt • Lime/lye/soda ash • Animal/human wastes • Rubber and plastic pellets or other small pieces • Uncured concrete/cement • Lead and copper, and any metals with oil/grease coating	• Clean recycled materials without discharge potential • Metal (excluding lead and copper, and any metals with oil/grease coating) • Sawdust/bark chips • Sand/soil • Unwashed gravel/rock	• Washed gravel/rock • Finished lumber (non-pressure treated) • Rubber or plastic products (excluding small pieces) • Clean, precast concrete products • Glass products (new) • Inert products • Gaseous products • Products in containers that prevent contact with stormwater (fertilizers and pesticides excluded)

Design Specifications

Design specifications for material storage areas are regulated by local building and fire codes, ordinances, and zoning requirements. Source control measures presented in this fact sheet are intended to enhance and be consistent with local code and ordinance requirements while addressing stormwater runoff concerns. The design specifications, presented in Table D-2, must be incorporated into the design of outdoor material storage areas when stored materials could contribute pollutants to the storm drain system. The level of controls required varies relative to the risk category of the material stored.

As general guidance, downspouts and roofs should be directed away from outdoor materials storage areas, and such storage areas should slope towards a dead-end sump to collect stormwater runoff, non-stormwater runoff, and spills. Stormwater runoff, non-stormwater runoff, and spills must be disposed of in accordance with local, state, and federal laws. Locations of design features, including the features presented in Table D-2, must be included on site maps or plans. Additionally, site maps or plans must show all storage areas for chemicals and/or waste materials, with a tank/drum schedule indicating tank capacities, materials of construction, and contents.

Table D-2. Design Specifications for Outdoor Material Storage Areas

Design Feature	Design Specifications
Surfacing	• High-Risk Materials: o Construct/pave outdoor material storage areas with Portland cement concrete or an equivalent impervious surface. Ensure that the surfacing material is chemically-resistant to the materials being stored. • Medium-Risk Materials: o Construct/pave outdoor material storage areas with Portland cement concrete. • Low-Risk Materials: o There are no requirements for surfacing.
Enclosures and Covers	• High-Risk Materials: o Place materials in an enclosure such as a shed, cabinet, or other structure that prevents contact with stormwater runoff; or o Cover entire storage area with a permanent canopy, roof, or awning to prevent precipitation from making direct contact with and collecting within the storage area. Direct stormwater runoff from the cover away from the storage area to a stormwater runoff disposal point that meets all applicable code, ordinance, and LID Standards Manual requirements. For cover structures that do not include sidewalls, include a roof overhang that extends beyond the grade break. o Covers 10 feet high or less should extend a minimum of 3 feet beyond the perimeter of the hydraulically-isolated storage area. o Covers higher than 10 feet should extend a minimum of either 20 percent of the cover's height or 5 feet beyond the perimeter of the hydraulically-isolated storage area, whichever is greater. o LACDPW may grant waivers for covers on a case-by-case basis. • Medium-Risk Materials: o At a minimum, completely cover material with temporary plastic sheeting during storm events. • Low-Risk Materials: o There are no requirements for enclosures or covers.

Table D-2. Design Specifications for Outdoor Material Storage Areas (continued)

Hydraulic Isolation and Drainage	• High-Risk Materials: o Hydraulically-isolate storage area with grading, berms, drains, dikes, or curbs to prevent stormwater run-on from surrounding areas or roof drains. o Direct stormwater runoff from surrounding areas away from the hydraulically-isolated storage area to a stormwater runoff disposal point that meets all applicable LID Standards Manual requirements. o Drainage facilities are not required for the hydraulically-isolated storage area. However, if drainage facilities are provided, drainage from the hydraulically-isolated storage area must be directed to a stormwater runoff disposal point as determined by LACDPW. • Medium-Risk Materials: o Drainage from storage area may be allowed, on a case-by-case basis with approval from LACDPW, to a treatment control measure or standard storm drain(s). o For erodible material, provide grading and a structural containment barrier on at least three sides of each stockpile to prevent stormwater run-on from surrounding areas and migration of material due to wind erosion. • Low-Risk Materials: o Provide appropriate drainage from the storage area to minimize contact with materials.
Spill Containment	• All Materials: o Implement spill containment measures where materials are stored in tanks, drums, or similar containers and that may potentially enter the storm drain system, sanitary sewer system, or contaminate the soil. Spill containment must be designed for the volume of the largest tank/drum or 10 percent of the tank/drum total (whichever is greater). o Separate spill containment systems for all tanks containing incompatible materials such as acids, bases, reactive or flammable materials. o Clean, repair, and seal (using epoxy or equivalent sealant compatible with the stored materials) the interior wall and floors within all spill containment areas. Identify the areas to be sealed on the site maps. o Bond the contact joint for spill containment walls or dikes constructed on existing concrete, masonry or asphalt to the existing surface. Identify the areas to be bonded on the site maps. o Cover the spill containment areas with a roof or awning to minimize collection of stormwater runoff within. o Store materials collected in spill containment areas until its quality and an appropriate approved disposal method have been determined.

Accumulated Water

Stormwater runoff, non-stormwater runoff, and spills will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and regulations, and cannot be discharged directly to the storm drain or sanitary sewer system without appropriate

permitting. Contact LACDPW (1-888-CLEAN-LA) for information regarding discharge of contaminated accumulated water.

Maintenance Requirements

The integrity of structural elements that are subject to damage (e.g., screens, covers, signs) must be maintained by the owner/operator as required by local codes and ordinances. Outdoor material storage areas must be checked periodically to ensure containment of accumulated water and prevention of stormwater run-on. Any enclosures and secondary/spill containment areas should be checked periodically to ensure spills are contained efficiently. Maintenance agreements between LACDPW and the owner/operator may be required. Failure to properly maintain building and property may subject the property owner to citation.

S-3: Outdoor Trash Storage and Waste Handling Area

Purpose

Stormwater runoff from areas where trash is stored or handled can be polluted. Loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or receiving waters. Waste handling operations (i.e., dumpsters, litter control, waste piles) may be sources of stormwater pollution.

Design Specifications

Wastes from commercial and industrial sites are typically hauled away for disposal by either public or commercial carriers that may have design or access requirements for waste storage areas. Design specifications for waste handling areas are regulated by local building and fire codes and by current County ordinances and zoning requirements. The design specifications, listed below in Table D-3, are recommendations and are not intended to conflict with requirements established by the waste hauler. The design specifications are intended to enhance local codes and ordinances while addressing stormwater runoff concerns. The waste hauler should be contacted prior to the design of trash storage and collection areas to determine established and accepted guidelines for designing trash collection areas. All hazardous waste must be handled in accordance with the legal requirements established in Title 22 of the California Code of Regulations. Conflicts or issues should be discussed with LACDPW staff.

Table D-3. Design Specifications for Outdoor Trash Storage and Waste Handling Area

Design Feature	Design Specifications
Surfacing	• Construct/pave outdoor trash storage and waste handling area with Portland cement concrete or an equivalent impervious surface.
Screens/Covers	• Install a screen or wall around trash storage area to prevent off-site transport of loose trash. • Use lined bins or dumpsters to reduce leaking of liquid wastes. • Use waterproof lids on bins/dumpsters or provide a roof to cover storage area enclosure (LACDPW discretion) to prevent precipitation from entering containers.
Grading/Drainage	• Berm and/or grade waste handling area to prevent stormwater run-on. • Locate waste handling area at least 35 feet from storm drains. • Divert drainage from adjoining roofs and pavement away from adjacent trash storage areas.
Signs	• Post signs on all dumpsters and/or inside enclosures prohibiting disposal of liquids and hazardous materials in accordance with any waste disposal ordinance.

Accumulated Water

Stormwater runoff, non-stormwater runoff, and spills will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and regulations, and cannot be discharged directly to the storm drain or sanitary sewer system without appropriate permitting. Contact LACDPW (1-888-CLEAN-LA) for information regarding discharge of contaminated accumulated water.

Maintenance Requirements

The integrity of structural elements that are subject to damage (e.g., screens, covers, signs) must be maintained by the owner/operator as required by local codes and ordinances. Outdoor trash storage and waste handling areas must be checked periodically to ensure containment of accumulated water and prevention of stormwater run-on. Maintenance agreements between LACDPW and the owner/operator may be required. Failure to properly maintain building and property may subject the property owner to citation.

S-8: Landscape Irrigation Practices

Purpose

Irrigation runoff provides a pathway for pollutants (i.e., nutrients, bacteria, organics, sediment) to enter the storm drain system. By effectively irrigating, less runoff is produced resulting in less potential for pollutants to enter the storm drain system.

General Guidance

- Do not allow irrigation runoff from the landscaped area to drain directly to storm drain system.
- Minimize use of fertilizer, pesticides, and herbicides on landscaped areas.
- Plan sites with sufficient landscaped area and dispersal capacity (e.g., ability to receive irrigation water without generating runoff).
- Consult a landscape professional regarding appropriate plants, fertilizer, mulching applications, and irrigation requirements (if any) to ensure healthy vegetation growth.

Design Specifications

- Choose plants that minimize the need for fertilizer and pesticides.
- Group plants with similar water requirements and water accordingly.
- Use mulch to minimize evaporation and erosion.
- Include a vegetative boundary around project site to act as a filter.
- Design the irrigation system to only water areas that need it.
- Install an approved subsurface drip, pop-up, or other irrigation system.[1] The irrigation system should employ effective energy dissipation and uniform flow spreading methods to prevent erosion and facilitate efficient dispersion.
- Install rain sensors to shut off the irrigation system during and after storm events.
- Include pressure sensors to shut off flow-through system in case of sudden pressure drop. A sudden pressure drop may indicate a broken irrigation head or water line.
- If the hydraulic conductivity in the soil is not sufficient for the necessary water application rate, implement soil amendments to avoid potential geotechnical hazards (i.e., liquefaction, landslide, collapsible soils, and expansive soils).

[1] If alternative distribution systems (e.g., spray irrigation) are approved, the County will establish guidelines to implement these new systems.

- For sites located on or within 50 feet of a steep slope (15% or greater), do not irrigate landscape within three days of a storm event to avoid potential geotechnical instability.[2]
- Implement Integrated Pest Management practices.

For additional guidelines and requirements, refer to the Los Angeles County Department of Health Services.

Maintenance Requirements

Maintain irrigation areas to remove trash and debris and loose vegetation. Rehabilitate areas of bare soil. If a rain or pressure sensor is installed, it should be checked periodically to ensure proper function. Inspect and maintain irrigation equipment and components to ensure proper functionality. Clean equipment as necessary to prevent algae growth and vector breeding. Maintenance agreements between LACDPW and the owner/operator may be required. Failure to properly maintain building and property may subject the property owner to citation.

[2] As determined by the City of Los Angeles, Building and Safety Division

S-9: Building Materials Selection

Purpose

Building materials can potentially contribute pollutants of concern to stormwater runoff through leaching. For example, metal buildings, roofing, and fencing materials may be significant sources of metals in stormwater runoff, especially due to acidic precipitation. The use of alternative building materials can reduce pollutant sources in stormwater runoff by eliminating compounds that can leach into stormwater runoff. Alternative building materials may also reduce the need to perform maintenance activities (i.e., painting) that involve pollutants of concern, and may reduce the volume of stormwater runoff. Alternative materials are available to replace lumber and paving.

Design Specifications

Lumber

Decks and other house components constructed using pressure-treated wood that is typically treated using arsenate, copper, and chromium compounds are hazardous to the environment. Pressure-treated wood may be replaced with cement-fiber or vinyl.

Roofs, Fencing, and Metals

Minimizing the use of copper and galvanized (zinc-coated) metals on buildings and fencing can reduce leaching of these pollutants into stormwater runoff. The following building materials are conventionally made of galvanized metals:

- Metal roofs;
- Chain-link fencing and siding; and
- Metal downspouts, vents, flashing, and trim on roofs.

Architectural use of copper for roofs and gutters should be avoided. As an alternative to copper and galvanized materials, coated metal products are available for both roofing and gutter application. Vinyl-coated fencing is an alternative to traditional galvanized chain-link fences. These products eliminate contact of bare metal with precipitation or stormwater runoff, and reduce the potential for stormwater runoff contamination. Roofing materials are also made of recycled rubber and plastic.

Green roofs may be an option. Green roofs use vegetation such as grasses and other plants as an exterior surface. The plants reduce the velocity of stormwater runoff and absorb water to reduce the volume of stormwater runoff. One potential problem with using green roofs in the Los Angeles County area is the long, hot and dry summers, which may kill the plants if they are not watered. See the Green Roof Fact Sheet (RET-7) in Appendix E.

Pesticides

The use of pesticides around foundations can be reduced through the use of alternative barriers. Sand barriers can be applied around foundations to deter termites, as they cannot tunnel through sand. Metal shields also block termites from tunneling. Additionally, diatomaceous earth can be used to repel or kill a wide variety of other pests.

Maintenance Requirements

The integrity of structural elements that are subject to damage (e.g., signs) must be maintained by the owner/operator as required by local codes and ordinances. Maintenance agreements between LACDPW and the owner/operator may be required. Failure to properly maintain building and property may subject the property owner to citation.

T-6: Proprietary Treatment Control Measures

Definition

The LID Standards Manual provided information for selecting and designing the more common treatment-based stormwater quality control measures for projects. The treatment-based stormwater quality control measures included in this appendix (T-1 to T-5) are non-proprietary (public domain) designs that have been reviewed and evaluated by LACDPW and determined generally acceptable.

Proprietary devices are commercial products that typically aim at providing stormwater treatment in space-limited applications, often using patented innovative technologies. The most commonly encountered classes of proprietary stormwater quality control measures include hydrodynamic separation, catch basin insert technologies, cartridge filter-type controls, and proprietary biotreatment devices.

Hydrodynamic separation devices (alternatively, swirl concentrators) are devices that remove trash, debris, and coarse sediment from incoming flows using screening, gravity settling, and centrifugal forces generated by forcing the influent into a circular motion. By having the water move in a circular fashion, rather than a straight line, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space as compared to wet vaults and other settling devices. Hydrodynamic devices were originally developed for combined sewer overflows, where they were used primarily to remove coarse inorganic solids. Hydrodynamic separation has been adapted for stormwater treatment by several manufacturers and is currently used to remove trash, debris, and other coarse solids down to sand-sized particles. Several types of hydrodynamic separation devices are also designed to remove floating oils and grease using sorbent media.

Catch basin inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media to remove floating oils and grease. There are a multitude of inserts of various shapes and configurations, typically falling into one of three groups: socks, boxes, and trays. The sock-type filters are typically constructed of a fabric, usually polypropylene. The fabric may be attached to a frame or the grate of the inlet may hold the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene “bag” is placed in the wire mesh box and the bag takes the form of the box. Most box products are one box; that is, settling and filtration through media occur in the same box. Other products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon. Inserts are an easy and inexpensive retrofitting option because drain inlets are already a component of most standard drainage systems. Inserts are usually only suitable for mitigating relatively small tributary areas (less than one acre) because they are limited by treatment capacity and influent flow rate.

Cartridge filter-type controls typically consist of a series of vertical filters contained in a vault or catch basin that provide treatment through filtration and sedimentation. The vault may be divided into multiple chambers where the first chamber acts as a pre-settling basin for removal of coarse sediment while another chamber acts as the filter bay and houses the filter cartridges. The performance and capacity of a cartridge filter installation depends on the properties of the media contained in the cartridges. Cartridge filter manufacturers often provide an array of media types each with varying properties, targeting various pollutants and a range of particle sizes. Commonly used media include media that target solids, such as perlite, and media that target both dissolved and non-dissolved constituents, such as compost leaf media, zeolite, and iron-infused polymers. Manufacturers try to distinguish their products through innovative designs that aim at providing self cleaning and draining, uniformly loaded, and clog resistant cartridges that functional properly over a wide range of hydraulic loadings and pollutant concentrations.

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as wetlands by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or higher volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through natural media (mulch, compost, soil, plants, microbes, etc) and either infiltrated or collected by an underdrain and delivered to the storm system. Tributary areas for biotreatment devices tend to be limited to 0.5 to 1.0 acres.

The vendors of the various proprietary stormwater quality control measures provide detailed documentation for device selection, sizing, and maintenance requirements. Tributary area sizes are limited to the capacities of the largest available model. The latest manufacturer supplied documentation must be used for sizing and selection of all proprietary devices. Links to the websites of a number of vendors of proprietary devices are provided at www.BMPLA.org. All proprietary devices proposed for use by a project applicant must be approved by LACDPW.

General Design Specifications

Proprietary stormwater quality control measure vendors are constantly updating and expanding their product lines, so refer to the latest design guidance from the vendors. General guidelines on the performance, sizing, and operation and maintenance of proprietary devices are provided through LACDPW Watershed Division.

Expected Performance

For hydrodynamic devices, it has been stated with respect to combined sewer overflows that the practical lower limit of hydrodynamic separation is a particle with a settling velocity of 12 to 16.5 ft/hr (0.10 to 0.14 cm/s). As such, the focus for hydrodynamic separation in combined sewer overflows has been with settleable solids generally 200 μm and larger, given the presence of the lighter organic solids. For inorganic sediment, the above settling velocity range represents a particle diameter of 50 to 100 μm. Thus, hydrodynamic separation devices are effective for removal of course sediment, trash,

and debris and useful for pretreatment in combination with other types of stormwater quality control measures that target smaller particle sizes.

Because there is a wide range of catch basin insert configurations, it is not possible to generalize the expected performance. Inserts should mainly be used for catching coarse sediments and floatable trash, and are effective for pretreatment in combination with other types of stormwater quality control measures. Trash and large objects can greatly reduce the effectiveness of catch basin inserts with respect to sediment and hydrocarbon capture. Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

Cartridge filters have been proven to provide efficient removals for both dissolved and non-dissolved pollutants. However, cartridge filters are less adept at handling high flow rates when compared to catch basin inserts and hydrodynamic devices due to the enhanced treatment provided through the filtration mechanism.

Because proprietary biotreatment devices are relatively new compared to the other types of proprietary treatment devices included in the LID Standards Manual, there are fewer third party studies on proprietary biotreatment devices. The available performance information is mostly vendor-supplied. According to the vendors, like their natural counterparts, proprietary biotreatment devices are highly efficient at mitigating dissolved metals, nutrients, and suspended solids.

Sizing

Hydrodynamic devices, catch basin inserts, and cartridge filters are flow-based stormwater quality control measures, but can be sized to capture and treat the mitigation volume of the SWQDv with additional facilities to manage stormwater runoff flow. Proprietary biotreatment devices on the other hand include both volume-based and flow-based stormwater quality control measures. Volume-based proprietary devices should be sized to capture and treat the mitigation volume of the SWQDv if used as a standalone stormwater quality control measure.

Auxiliary components of proprietary devices such as sorbent media, screens, baffles, and sumps are selected based on site-specific conditions such as the expected loading and the desired frequency of maintenance. Sizing of proprietary devices is reduced to a simple process whereby a model can simply be selected from a table or a chart based on a few known quantities (tributary area, location, design flow rate, design volume, etc). Some manufacturers either size the devices for potential clients or offer calculators on their websites that simplify the design process even further and lessens the possibility of using obsolete design information. For the latest sizing guidelines, refer to the manufacturer's website.

Operation and Maintenance

Hydrodynamic Separation Devices

Hydrodynamic separators do not have moving parts and are not maintenance intensive. However, maintenance is important to ensure that the device operates as efficiently as possible. Proper maintenance involves frequent inspections throughout the first year of installation, especially after major storm events. The systems are considered full when the sediment level is within one foot from the top of the unit, at which point it must be cleaned out. Removal of sediment can be performed with a sump vacuum or vactor truck. Some hydrodynamic separator devices may contribute to mosquito breeding if they do not fully drain stormwater runoff between storm events. Refer to manufacturer's guidelines for inspection and maintenance activities.

Catch Basin Inserts

Catch basin inserts can be maintenance-intensive because of their susceptibility for accumulating trash and debris. Regular maintenance activities include the clean-up and removal of accumulated trash and sediment while major maintenance activities include replacing filter media (if used) and or repairing/replacing geomembrane fabrics. Refer to manufacturer's guidelines for inspection and maintenance activities.

Cartridge Filters

For cartridge filters, maintenance activities include periodically removing trash, debris, and sediment from the vault floor, typically twice per year depending on the accumulation rate, using a sump vacuum or vactor truck. The cartridges may need to be replaced when they become saturated, which will occur approximately every other year depending on the pollutant accumulation rate. The manufacturers of these devices typically provide contract operation and maintenance services.

All stormwater vaults that contain standing water can become a breeding area for vectors. Manufacturers have developed systems, such as a perforated pipe installed in the bottom of the vault that is encased in a filter sock to prevent clogging, to completely drain the vault.

Biotreatment Devices

Maintenance of biotreatment devices can be provided by the manufacturer and typically consists of routine inspection and hand removal of accumulated trash and debris. Vactor trucks or mechanical maintenance activities are not needed for biotreatment devices.

Attachment H

Pollutants of Concern

Table 7-3. Typical Pollutants of Concern by Land Use [1]

Land Use	Pollutants of Concern [2]								
	Suspended Solids	Total Phosphorus	Total Nitrogen	Total Kjeldahl Nitrogen	Cadmium, Total	Chromium, Total	Copper, Total	Lead, Total	Zinc, Total
High Density Single Family Residential	X	X			[4]	[4]	X	X	X
Multi-Family Residential	X				[4]	[4]	X		X
Mixed Residential	X	X	X		[4]	[4]	X	X	X
Commercial	X	X	X	X	[4]	[4]	X	X	X
Industrial	X	X	X	X	[4]	[4]	X	X	X
Critical Facilities [3]	X	[4]	[4]	[4]	[4]	[4]	X	X	X
Transportation (streets, roads)	X	X	X	X	[4]	[4]	X	X	X
Institutional (educational facilities)	X				[4]	[4]	X		X

[1] Adapted from Table A-3 of the *Technical Manual for Stormwater Best Management Practices in the County of Los Angeles* (February 2004) and the Southern California Coastal Water Research Project Land Use Specific Storm Water Monitoring Data. X = exceedance of "standard" by observed median/average concentration; blank = no exceedance of "standard" by observed median/average concentration.

[2] Derived from Table 11 of the 2012 Los Angeles County MS4 Permit (page 104).

[3] Critical facilities include automobile dismantling (SIC 50xx), automobile repair (SIC 75xx), metal fabrication (SIC 34xx), motor freight (SIC 42xx), automobile dealerships (SIC 55xx), chemical manufacturing (SIC 28xx), and machinery manufacturing (SIC 35xx).

[4] No available data to determine if these pollutants of concern originate from this land use. Pollutant is assumed to be produced by this land use unless otherwise proven by the project applicant.

OFFSITE RUNON	Offsite runon not anticipated.
UTILITY AND INFRASTRUCTURE INFORMATION	There are no known existing onsite utility and/or infrastructure that will conflict with proposed stormwater facilities. The proposed sewer, water and dry utility improvements designed to not conflict with proposed subsurface infiltration system.
SIGNIFICANT ECOLOGICAL AREAS (SEAS)	There are no known SEAs.
RECEIVING WATERS	Receiving waterbodies that follow are Walnut Creek Wash, San Gabriel River Reach 3, San Gabriel River Reach 2, San Gabriel River Reach 1 and the San Gabriel River Estuary. The above mentioned receiving waterbodies are listed for water quality impairment on the most recent 303(d)-list for: * Benthic-Macroinvertebrate Bioassessments * Indicator Bacteria * pH * Coliform Bacteria * Cyanide * Lead * Copper * Dioxin * Nickel * Oxygen, Dissolved

MALIBU CREEK WATERSHED MANAGEMENT AREA

Parameter	Parameter
E. coli Bacteria	Total Dissolved Solids
Cyanide, Total Recoverable	
Mercury, Total Recoverable	
Selenium, Total Recoverable	
Sulfate	

SAN GABRIEL RIVER WATERSHED MANAGEMENT AREA

Parameter	Parameter
pH	Cyanide, Total Recoverable
E. coli Bacteria	Cadmium, Total Recoverable
Total Coliform Bacteria[1]	Copper, Total Recoverable
Fecal Coliform Bacteria[1]	Lead, Total Recoverable
Enterococcus Bacteria[1]	Mercury, Total Recoverable
Chloride	Nickel, Total Recoverable
Nitrate Nitrogen, Total (as N)	Selenium, Total Recoverable
Sulfate	Silver, Total Recoverable
Total Dissolved Solids	Zinc, Total Recoverable
Aluminum, Total Recoverable	

[1] Apply only to discharges to the estuary and the ocean

SANTA CLARA RIVER WATERSHED AREA (LA County portion only)

Parameter	Parameter
E. coli Bacteria	Aluminum, Total Recoverable
Chloride	Cyanide, Total Recoverable
Sulfate	Copper, Total Recoverable
Total Dissolved Solids	Mercury, Total Recoverable
Methylene Blue Active Substances	Selenium, Total Recoverable